

DRAFT  
TECHNICAL REPORT

TRANSPORTATION FINANCING

Vehicle Miles Traveled (VMT) Measurement and Assessment

Transportation Planning Program  
California Department of Transportation

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## **PREFACE**

The statements and recommendations provided in this policy research do not necessarily reflect the official position of the California Department of Transportation. The research was developed by the staff to provide information and analytic basis for the management decision process. The study might be useful to transportation community and institutions interested in transportation financing and value oriented pricing.

The study is intended to provide a framework for analysis and evaluation of transportation pricing, particularly Vehicle Miles Traveled. The text consists of three separate but interdependent readings; the Executive Summary, the White Paper, and the extended Technical Report. It is suggested that the reader refer to the Technical Report for further analysis and clarification of statements provided in the Executive Summary and the White Paper.

The first three chapters of the Technical Report concern an analytic discussion of pricing issues and review of technology and VMT concepts. The last three chapters focus on the major issues concerning transportation financing, evaluation framework and quantification of scenarios regarding transportation pricing and financing reform, including both short and longer term policy recommendations.

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## TABLE OF CONTENTS

Preface.....	ii
Table of Contents.....	iii
List of Tables .....	v
 CHAPTER I - Introduction .....	 1
Problem Statement .....	2
Objective .....	3
Scope of Study .....	4
 CHAPTER II – Analytic and Policy Discussion .....	 6
Transportation pricing: Is it a Financing Mechanism or a Congestion Management tool? .....	6
Is The Existing Financing System Broken? .....	8
Analytical Problems with Transportation Pricing Studies .....	10
Replacing or Reforming the Existing System? .....	12
 CHAPTER III – Alternative Pricing Options .....	 14
Vehicle Miles Traveled Fee – An Alternative to the Existing Fuel Based System?.....	14
VMT Variations.....	16
VMT/Flat Fee .....	16
VMT/Flat Fee with “Cold Start” .....	17
VMT Differential Pricing.....	17
Emissions Differential Pricing.....	19
VMT/Emissions Differential Pricing at the Pump.....	19
Congestion Pricing/Emissions Differential.....	20
Viable Pricing Technology.....	20
Technology Options and Pricing Strategies.....	22
The Nature of the Process – Non-Technology Issues.....	24
 CHAPTER IV – Scenario Analysis and Evaluation.....	 26
Alternative Scenarios.....	26
Setting the Strategic Objectives.....	28
Trucks and Goods Movement.....	29
Evaluation Framework.....	30
Analysis of Surface Transportation Financing.....	32
Base Case Scenario – The Existing System.....	32
Alternative Fuels and Vehicles Market Penetration.....	36
Vehicle Fuel Efficiency.....	42

Combined VMT Fee and Fuel Tax Structure – Full Freeway System.....	46
Full VMT System.....	52
Comparative Revenue Implications of Alternative Scenarios.....	53
CHAPTER V – Framework for Evaluating Revenue Sources.....	55
Evaluation of Selected Alternative Sources.....	57
Full VMT Pricing.....	57
Combined VMT Fee and Fuel Tax Structure – Full Freeway System (Flat and Variable Fee).....	59
VMT/Emissions Differential Pricing.....	61
Maintaining fuel tax system (programming reform, increase gas tax).....	63
A. Increase Gas Tax.....	63
B. Programming Reform.....	65
Summary Comparison.....	67
CHAPTER VI – Policy Options and Recommendations.....	69
The Most Feasible Alternative.....	69
Recommendations.....	71
A. Reforming the Fuel Based System – near term options (5 to 10 years).....	71
B. Introduction of VMT Pricing (variable rate schedule ) on Full Freeway System: Emerging System – mid term (10 to 15 yrs).....	75
References.....	78

## LIST OF TABLES

Exhibit 1	Scenario Evaluation Framework.	32
Table 1	Future Needs Assessment - 20-Year non-Capital and Capital Needs.	34
Table 2	Annual State Transportation Revenue Receipts.	35
Table 3	Projected Gas Tax Receipts for State Highway System.	36
Figure 1	Forty-year History of California Gasoline price and its Component Tax Share.	37
Table 4	Current and projected Number of AFVs in California.	38
Table 5	Taxes Applied to Sales of Highway Motor Fuels in California.	39
Table 6	Projected Light Duty Vehicle Gasoline Displacement by Alternative Fuels.	40
Table 7	Projected Potential Revenue Loss to Surface Transportation by Alternative Fuels.	40
Table 8	Ranges of Technically Achievable Fuel Economy for Model Year 2006 Gasoline Passenger Car.	44
Figure 2	Historical Trend in VMT, Fuel Consumption, Fuel Economy, and Fuel Tax Rate.	45
Table 9	Projected Potential Revenue Loss to Surface Transportation Due to Light Duty Vehicle Fuel Economy.	46
Table 10	Revenue Loss to Surface Transportation Due to Penetration and Fuel Economy of Electric Vehicles.	46
Table 11	Flat VMT Fee/Light Duty Vehicle - Projected Revenues from State Freeway System.	49
Table 12	VMT Variable Fee/Light Duty Vehicle - Projected VMT Fee Receipts from State Freeway System.	50

Table 13	Projected Revenue - Combined Fuel Based System and VMT Fee.	51
Table 14	Magnitude of System Costs (unescelated) VMT Freeway System.	52
Table 15	Full VMT System/Flat Fee - Projected Revenue from State Roadway System.	54
Exhibit 2	Comparative Revenue Implication of Alternative Scenarios.	55
Table 16	List of Evaluation Criteria.	57
Table 17	Summary Comparison - Fuel Based System, VMT Fee System, and Combined VMT/Gas Tax.	69

# **TECHNICAL REPORT**

## **TRANSPORTATION FINANCING**

### **Vehicle Miles Traveled (VMT) Measurement and Assessment**

#### **CHAPTER I**

##### **Introduction**

The Commission on Transportation Investment (CTI) was convened by the Secretary of the Business, Transportation and Housing Agency (BT&H) to investigate California's investment in transportation infrastructure. The Commission's report published in January of 1996 produced a series of findings and policy recommendations. The recommendations are intended to provide a framework for the future of transportation in California.

One of the critical areas the Commission focused on was transportation financing. The Commission recognized that the current structural deficiencies in transportation revenues, produced by a variety of factors, including governmental policies and technological advancement, have resulted in decreased buying power over the last twenty years.

The Commission discussed several alternatives to the current system of collecting tax revenues for transportation purposes. One option was to find new mechanisms that charge drivers the true costs of the transportation choices they make, and charge them appropriately for it. This option led to two interrelated recommendations. One was the further analysis of the congestion and direct road pricing (Recommendation B5) and the other, continued research in Vehicle Miles Traveled measurement and assessment (Recommendation B3). These two recommendations overlap and have similar analytic structure depending on strategic policy objectives. The Agency requested that Caltrans prepare a comprehensive report concerning Recommendation B3.

This report focuses on the Vehicle Miles Traveled (VMT) concept while making proper reference to congestion pricing and underlining their structural and topological similarities, where appropriate. The report provides a critical review and analysis of the VMT methods of financing surface transportation. It examines the types of VMT mechanisms and practical implications of VMT assessment and measurement, administrative and technological requirements, taking into account both revenue generating and congestion management potential of implementing the system.

## **Problem Statement**

Concerns about transportation financing and funding shortfalls, maintaining the existing roadway system, and reducing congestion, along with the changing nature of transportation fuel infrastructure and technologies, have led to renewed studies of the actual cost of transportation with an eye towards additional ways to pay for needed transportation facilities and services.

Petroleum-based motor fuel taxes (gasoline and diesel), including truck weight fees, have been the primary sources of traditional highway funding in the United States. This revenue source had been viewed as a direct user fee and, until recently, considered a reliable and cost-effective method of generating revenue. There is a growing perception, however, that the motor fuel tax system has lost its effectiveness as a primary financing mechanism for surface transportation programs.

Several factors seem to be contributing to this perception. It is argued that gas taxes, generally, have not kept up with other price increases, inflation or needs. Improvements in motor vehicle technology and the development of alternative fuels have diminished the effectiveness of fuel taxes as a direct measure of highway use, with the net effect of reducing the rate of the revenue generated from fuel consumption. This effect is intensified by the increasing number of vehicles using the highways, longer and multi-purpose trips, and decreasing vehicle occupancy. As a result, the linkage between the gas tax and the use of transportation facilities has been weakened, making it a less of a user fee. This problem has been referred to as the “disconnect” of the fuel tax from the transportation system user.

At the same time, public policies and practices stemming from energy issues, environmental concerns, and deficit reduction have further reduced the amount of money available for transportation services, notwithstanding the importance of these national policies. This has undermined the concept of dedicated funds from motor fuel tax receipts. Motor fuel taxes are increasingly used to implement mandates by federal government related to transportation externalities and impacts, including non-transportation purposes.

In addition, the state, local, and regional governments are increasingly bearing a larger share of the transportation funding need. Sales tax measures have become a major part of the local funding source for surface transportation programs, particularly for transit. Local governments have often used this source as solutions to fiscal problems or help pay for other programs. The future of this revenue source, however, has been put into serious doubt, because of the recent legislation concerning the two-thirds

majority vote requirement to approve a sales tax measure. A majority of the local counties' sales tax measures will sunset within the next ten to fifteen years, potentially causing further transportation programming imbalances, unless restrictions on extending these measures are lifted.

As a result of these emerging trends, the reliability of existing methods of transportation financing are being questioned. Many in the transportation community are searching for alternative methods to ensure a reliable flow of funds to maintain long-range planning and programming. Others have readily embraced a user fee approach for financing the surface transportation system. It is clear that in light of current and likely future scenarios, transportation financing is an area requiring critical evaluation. Improvements and alternatives to the existing financing structure should be analyzed and pursued to assist public officials in making decisions on the future of the system.

Searching for the right strategies must be done realistically. The focus should be on improving the relationships between transportation operations and the corresponding financial structure, as well as the criteria or framework for transportation investments. Many of the recent generation of reports on transportation pricing exaggerate or misconstrue the problems of the current system of roadway financing while simplifying the feasibility of alternative approaches and their consequences.

## **Objective**

The objective of this report is to evaluate potential revenue alternatives and establish a more direct link between transportation finance and the benefits generated from transportation services. The report will identify typology and evaluate the Vehicle Miles Traveled method(s) and compare it with the traditional motor fuel tax for financing surface transportation programs. The conceptual and methodological qualities and problems of the VMT pricing approach, including critical issues of debate, will be analyzed. The underlying rationale surrounding this method as a public policy instrument will be discussed.

It is also intended that the content of this report initiate the conversation about specific market-based strategies, such as a VMT fee, to complement or substitute fuel tax and constitute a new source for transportation revenues in California. Further, it is intended to inform stakeholders, citizens, elected officials and staff about some of the specific impacts that these strategies will produce. Finally, the reports outlines a potentially workable set of strategies, in response to a set of criteria and an evaluation framework.

## Scope of Study

This study examines VMT fees for its revenue generating capability and practical feasibility and whether it would constitute a structurally responsive financing system. The report underlines the financial potential of VMT relative to the internal cost of transportation operations, rather than transportation externalities. However, the potential external benefit is of particular interest. The emphasis is on measures to improve the relationships between the transportation infrastructure, its corresponding financial system, and the use of transportation facilities.

The report suggests certain criteria and a framework for evaluating transportation pricing, particularly the VMT financing method, under different scenarios. The financing, rather than strategies to influence travel behavior or managing congestion, is of primary interest. The revenue generation methods and direct efforts to induce behavioral change through pricing are analytically differentiated. The report underlines certain facts about the existing fuel-based financing structure which is often used as a basis and justification for developing alternative methods by various advocates.

Furthermore, the study differentiates between facility specific pricing strategies, such as toll roads and high occupancy toll lanes and that of region wide, comprehensive pricing methods for financing the transportation system as a whole. The former is technologically and administratively viable. While the latter is problematic. This study is primarily concerned with a large scale, multi-purpose pricing program. It must be noted that establishing a pricing method to complement or substitute the existing fuel tax system should be approached carefully and incrementally. A large pricing system, however, often evolves out of a single facility or a defined network of sub-systems, expanding to its full potential over a period of time.

For analytical purposes, this report differentiates between light duty vehicles (private auto) and heavy duty vehicles (trucks) in the process of evaluating pricing scenarios. The roadway cost responsibility for trucks is significantly higher than private auto, but they also provide a significant contribution to the economy of the state in terms of distribution of goods and services. It is recognized that to be analytically objective, the application of the user fee method for trucks using the roadway system should take into consideration additional factors directly relevant to the movement of goods and services (i.e., economic and social good factors). This is to ensure that the evaluation framework and criteria are responsive to various classes of vehicles and their functional role. While the evaluation method and implementation of the VMT pricing system remain the same for both light and heavy duty vehicles, this study focuses on private auto to analyze alternative revenue sources. Finally,

it must be noted that figures and statistics presented in this report are reflective of the direction, range, and magnitude of impacts or outcome rather than specific targets. Accounting accuracy was not intended.

## CHAPTER II

### Analytic and Policy Discussion

#### **Transportation pricing:**

#### **Is It a Financing Mechanism or Congestion Management tool?**

Pricing the use of roads is not a new idea. Many early turnpikes of the late 17th and early 18th century in United States were built as private toll roads. During the modern era, many other toll roads were built by public agencies in the 1940s and 1950s, particularly to finance expensive bridges and tunnels. The implementation of the Interstate and Defense Highway system as a network of untolled expressways in 1956, however, set a new course that favored highway financing through fuel or other fairly broad based taxes rather than through charges for the use of specific facilities. In the private sector, the telephone industry and airlines have long used pricing in managing peak loads, seasonal, and time sensitive demand.

Road pricing is again attracting interest for two distinct but interrelated reasons. One is to generate revenue in light of budgetary shortfalls, particularly for new or upgrading existing highways. A number of states began to consider tolls as a means of highway financing as the completion of the interstate highway system neared. This was further rationalized by growing public opinion against tax increases.

Another reason and more recent motivation to use road pricing is to manage congestion and air pollution as well as other external impacts of auto use. Growing popular concern about these problems along with frustration regarding the limitations of conventional approaches, is attracting increasing attention for the use of pricing to control demand on highway facilities. Environmental groups are particularly keen on this aspect of road pricing, while public and government agencies are more interested in the revenue potential, given their budgetary concerns and future transportation needs.

The diversity of interest in transportation pricing makes it critically important to clearly underline the strategic objectives of a pricing program. Whether the objective is congestion and mobility, air quality improvement, or revenue generation, they must be identified, evaluated, and prioritized. These apparently different strategic objectives are highly interrelated and have similar analytic structure. The differences between them, generally, is related to such factors as the motive and public concern, scale and level of pricing, level of complexity, criteria for measuring the cost, and how the

revenues are earmarked. The primary intent of this report is the focus of the pricing program and not to exclude other transportation related objectives.

In order to have proper strategic policy value, it is important to define transportation pricing for what it is and characterize it for the purpose of a research or policy analysis (see next section). Congestion pricing implies that prices will be tailored to congestion levels to encourage people to use alternative routes, modes, or defer travel all together. By contrast, altering travel behavior is not the principal concern in pricing designed primarily to raise revenue. It is clear, however, that congestion pricing often generates large sums of money which could be used for transportation investments and likewise, a pricing strategy for raising revenue has the potential to affect travel demand.

Studies show, however, that auto use and its impacts are quite inelastic (1). As a result, large price increases are necessary to obtain sizeable reductions in travel and its externalities. This means that it is only at higher fee charges that a pricing strategy can begin to act as a deterrent for auto use and, therefore, a congestion management tool. It is noteworthy that setting a user fee too high, beyond the true cost imposed by drivers, and for the purpose of a deterrent, is unrealistic policy approach with socioeconomic, political and equity consequences. Further, the social and environmental costs of auto use and the cost responsibility of drivers are a matter of debate and subject to a good degree of scientific speculation at this time. There is a huge disparity on social and environmental cost estimates produced by various studies.

The distinction between pricing as a financing mechanism or a congestion management tool include other important elements. The scale or geographical area would further delineate the difference. Congestion pricing, by its definition, focuses on reducing congestion and, therefore, it is facility or sub-area specific. For example, a fee is exacted when using a facility or entering a congested area such as downtown. But a pricing strategy, for the purpose of financing a transportation system as a whole, goes beyond a facility or sub-area. In this case, congested and non-congested areas must be differentiated. The fee can be a flat charge similar to gas tax or a variable fee. A variable rate requires technologically more advanced and sophisticated environment. This system, however, could be more responsive to the type of facility, level-of-service, or vehicle characteristics when compared to a flat fee system.

This report subscribes to the notion that, in practical terms, large scale transportation pricing is primarily a financing mechanism having potential positive impacts on travel behavior. The intent is to establish a more direct relationship between user of the transportation facilities and the financing of

the system. The rationale for this is that the sociopolitical and economic realities are, in most part, prevailing factors in determining the pricing strategy and the range of user fees, rather than congestion level. However, it is recognized that environmental concerns and transportation externalities are important factors which are fueling the debate over the transportation financing reform.

The point to be emphasized is that the pricing strategy, its justification (public and political), and policy formulation may differ widely depending on whether the objectives are defined as fighting congestion or establishing new sources of revenue and reform of the financing system. For example, if air quality is the focus of the pricing program, it would be more effective to target high-emitting vehicles to reduce emissions or, better yet, push for cleaner fuel and high performance engine technologies rather than pricing congestion.

The issue of transportation pricing and reform present the greatest challenge to transportation planners and policy makers. It requires a cultural change in the transportation environment, both for users and providers of the system. The users of the current fuel based transportation system appear less demanding and more forgiving.

### **Is The Existing Financing System Broken?**

It appears that this type of question is improperly posed by many studies dealing with transportation financing. The major issue is not that the current financing system is broken or soon to be broken. This is obviously an exaggerated characterization of the system. The important questions are: what are the strengths and weaknesses of the system, how can its efficiency can be maximized, and what are the alternative courses of action that can complement the system. This puts the existing system in the proper context and would set the stage for the reform of the system and, in the long term, perhaps its transformation. The main argument is about the weakening relationship between the gas tax and transportation system users, establishing a clear linkage between what type of services the users of the system want, and how much they are asked or, even, willing to pay. Further, decision makers are also concerned with properly realigning the financial structure of the current system and its investment decision making strategies and criteria, underlining market oriented approaches such as the return-on-investment.

The structural problems associated with the existing roadway finance system and the causes of transportation financing problems are often exaggerated or misconstrued. This is evident in many of the alternative proposals which fail to understand the complexity of the transportation system, its behavioral

environment, and implementation requirements. In most of these cases, it seems, increased revenue, if any, is short term and unlikely to generate enough money to meet the needs of transportation system as a whole. Some studies appear to reduce a complex, interactive transportation system and its financial structure with sociopolitical, technological, spatial, and human dimensions to pure, for example, economics or a mechanical structure (2).

Some suggest that the revenue short fall is due to the fact that the fuel tax rate has not kept up with other price increases. Others suggest that the problem with the existing system is the funding allocation process and not necessarily the level of revenue. Still others think the primary cause is the poor operating characteristics of roads as well as a deterioration in the financial competence of the road financing system. They view the political and legislative processes as an obstacle to efficient allocation of resources. The emphasis appears to be on procedural and decision making processes rather than the structural deficiency of the existing fuel-based system.

Regardless of the critical and analytic arguments, it is clear that the existing fuel-based transportation financing system is essentially rational and has worked fairly well. It is simple, but not simplistic. The fuel tax directly correlates driving with fuel consumption, in variable degrees. It is also indirectly correlated with the use of the roadway through an average VMT, although inproportionate, due to vehicle fuel economy. The fuel based revenue structure is practical, easily implementable, and probably the most cost effective pricing measure at this time. If fuel taxes are below the marginal cost of driving, the problem is political and legislative rather than a structural with the fuel-based system. No studies have been able to demonstrate that their alternatives are practically less complex, administratively more feasible, and generate more money than the existing system, given moderate and comparative charges. This is not to suggest that the present system does not have problems. To the contrary, it is increasingly evident that while the present system is rational, it needs to be diversified and complimented with creative financing measures in response to changes in the transportation environment. The point to be made is that, to reform the existing system, it is important to put it in the proper perspective and measure up alternative courses of action comparatively. The alternatives presented by the opponents of the existing system while appear attractive, they are often impractical.

It is interesting to note that a less discussed but important issue in transportation financing is taxation. Historically, the adjustment in the fuel tax rate has not been a reliable process. It is politically sensitive, legislatively complex, is affected by non-transportation issues, and intrigued by national and international events and politics. On the other hand, the concept of fees is a less conspicuous form of tax. However, whether it is road pricing, congestion pricing, or the fuel tax, decision makers are faced with

essentially the same type of challenge. It is not clear that dealing with fees rather than fuel taxes is politically less challenging, particularly if the rate is substantially higher than the gas tax. Further, public expectations and pressure for accountability on the part of transportation providers and measurable improvements in transportation services would certainly increase with a pricing system.

There appears to be common ground and objectives between those advocating the reform of the existing system and those calling for its transformation. What is dividing them is the rationale reflective of their professional views and ideological commitments. The strategic differences among pricing advocates seem to have divided the transportation financing debate over motive or rationale rather than a need, thereby, weakening the promise of market-based reforms.

### **Analytical Problems with Transportation Pricing Studies**

Some of the recent generations of studies on transportation pricing lack structural and analytic quality. They do not properly define the system which they are evaluating for the purpose of their studies. Transportation and its behavioral environment consists of interconnecting, but differentiable multi layered sub-systems. Is it the physical structure(s) they are referring to or its corresponding financial structure? Is it the lack of an integrated intermodal network or the inefficiency of the existing roadway system? Is it the managerial, organizational, and investment decision making structure or the framework and philosophy within which the decisions are made? These aspects have affected the transportation system and its financing structure in different ways.

The lack of properly defining the system (and system processes), internal relationships, and putting the financing problem in context not only presents analytical problems but it could potentially be misleading. For those who are thinking in an operational term, it is totally unjustifiable, for example, to label the existing roadway system(s) as broken, given the fact that it carries more people, goods, and services than other modes. The issue is not that the system is inefficient, but that it is reaching its threshold (in urban areas) and cannot continue to accommodate growth and increased vehicles. Operational deficiencies due to congestion and growth should be, in large part, differentiated from the physical condition. If problems of the existing system are being dramatized to draw attention, then the issue is one of style rather than substance. If the problem is stated in terms of maintenance needs and funding shortfalls, those issues have very little to do with how efficient the system operates.

Further, some proposed models are primarily concerned with the roadway system and not the transportation system as a whole (2). Operational problems are isolated by facility type rather than a network of roadways. This presents conceptual and methodological flaws in their analysis. Operational solutions seem to be confined to increased capacity within specific facilities and not in the context of integrated network of roadways. Further, other transportation modes are considered as separate from and unrelated to roadway performance. Therefore, alternative modes are not considered as part of the solutions nor are funded from the roadway account.

Another problem with many of the studies' conceptual and modeling analyses is a major gap between actual experiences or the real world information and the liberal use of the limited data bases, extensive assumptions, and modeling results. While transportation pricing is an attractive subject and certainly a significant policy issue, there have been practically no applications of pricing, particularly on a system-wide basis in California/United States, excluding facility specific pricing such as toll bridges or roads. The research and discussion on this topic often seem persuasive and demonstrate that transportation pricing makes socioeconomic sense. But, most have acknowledged difficulties in implementing such a system(s) on a regional or statewide basis. The pricing method as a pure demand management and air quality enhancement strategy remains in large part untested.

Generally, socioeconomic issues associated with a large scale pricing system are not well studied and their potential long term implications are not well known. Long term issues, such as land use and economic growth, seem to be depending on the particular pricing strategy and the magnitude of its application. For example, the larger the scale of the pricing program and more moderate the fee, the more difficult it is for drivers to avoid paying tolls by moving further out. Also, the issue of whether the pricing system would put the region or the state in disadvantage to its neighboring non-priced regions or states needs closer evaluation.

Answers to many questions concerning transportation pricing have so far been confined to conceptual and prototype studies as well as through the market research/public out-reach process, and is by no means complete. None of the studies so far have been able to convincingly demonstrate and evaluate pricing measures by type and their consequences. Analysis of traffic flow, revenue, air quality and congestion is mainly on a theoretical and aggregate basis. Short term real time evaluation of facility specific differential pricing is beginning to emerge (i.e. SR 91). It appears that incremental approaches to pricing with carefully crafted demonstration projects are a reasonable means to experiment with transportation pricing and make a case for its needs and effectiveness.

## **Replacing or Reforming the Existing System?**

Regardless of the type of pricing method, strategic objectives, motivational differences among pricing advocates, or analytic problems with research efforts, one thing is clear; a user-based fee system cannot easily and readily replace the existing fuel-based system. The transportation system is predominantly operated through conventional fuels. This is true as long as gasoline/diesel remain the primary energy source that is fueling the system. Replacing the gas tax with a fee not only does not fundamentally change the institutional and administrative infrastructure already in place, it will create additional layers. Replacing the existing system may also be counter productive, amounting to inadequate revenue or very high user fee structure, not considering the extensive capital and operation costs associated with the new system. Pricing advocates admit that it is necessary to maintain a modest motor fuel tax in addition to road-user charges to provide the missing revenue to the road system. At the same time, studies show that the traffic volume reduction as a result of congestion pricing is rather small and short term.

According to a recent study (3), in the current system the users of uncongested roads pay about the right amount, two cents per mile (based on maintenance cost) while the users of the congested urban facilities pay less than their actual cost responsibility. The drivers on congested urban facilities may not be paying enough, but no one is paying too much. Underpricing of congested capacity can be mitigated with measures complimenting the existing system. More importantly, the present fuel based system actually allows formulation of creative financing strategies to be made more effectively. Because, it allows improvement measures to be implemented selectively on the most seriously congested facilities or sub-areas and it can be more equitable. In the long term, these experiences provide empirical knowledge on intricacies of pricing methods which otherwise are a matter of speculation. In other words, the existing system provides a stable footing for experimentation and demonstration of market-based strategies and a piece-meal approach in reforming the system and eventually its transformation. A whole sale approach in changing the existing system is not feasible. Toll roads, priority toll lanes, and other privatization strategies are, for example, emerging as supplementing the existing financing system, generating more revenues, and improving traffic operations on congested facilities, however, are short term.

Some of the major variables that are undercutting the effectiveness of the fuel based pricing system are, indeed, outside of the main stream discussion on transportation pricing. Whether the gas tax will continue to be a viable method in transportation financing is dependent, in large part, on the penetration of the alternative fuels and vehicles, particularly electric cars

and transportation technologies, including high vehicle efficiency. Other issues such as the fluctuating and increasing cost of imported oil, reliance on foreign energy sources as well as depleting oil reserves and strategic security, are of critical importance. At the same time, the fuel economy and the rate of alternative fuel market penetration are, in large part, conditioned by state and federal policies and technology breakthroughs. Congestion and operational issues as well as transportation externalities, while facilitating the direction of transportation pricing are, in real terms, secondary.

These factors complicate the relationships between the congestion, transportation externalities, and environmental issues. The rationale for congestion pricing because of its external benefits weakens as a result. For example, assume that the objectives of the Air Resources Board low-emission regulation is realized and hypothesize a situation where most of the California vehicle fleet is low-emission or electric. In this scenario, there is little relationship between congestion, driving habits, and the air pollution. The environmental issues will probably be transformed with a new generation of environmental concerns (i.e., disposing cell batteries).

This argument suggests that, in a foreseeable future, the existing system remains the primary method of transportation financing. It should be reformed but cannot be easily transformed. Transformation is incremental and will come in planned stages. The problem is not necessarily the rate of gas tax or fee to generate more revenue, although that is a short term issue, but properly realigning the financial structure of the existing system along with the cost responsibility by users of the system and its investment decision making criteria and allocation process. A systemwide approach to pricing other than the gas tax is conceptually compelling, but practically conditional. Further, the idea that a large scale, user based pricing system could solve many transportation problems is rather naive. It is a mistake to suppose that by simply charging a “penny” a mile or “eighteen cents” a mile, assuming that is operationally feasible, transportation problems will be resolved. Such an idea misses the inner workings of a complex system and its behavioral environment.

## CHAPTER III

### Alternative Pricing Options

There are at least three major categories of transportation financing alternatives; user fees, non-user fees, and debt financing and privatization. There is a range of revenue sources within each category and many variations of each method. User fees can take a variety of forms, ranging from simple schemes in which a toll is collected from a vehicle entering a facility or congested area to more complex measures in which the toll paid varies by distance traveled, the level of congestion, or vehicle characteristics i.e. emission rate, weight, axle, etc. The practical possibilities for implementing more complex schemes, such as VMT fee, particularly on facility specific or sub-area, are changing rapidly with new developments in automated vehicle identification and charging.

This report is concerned with the user-based system, specifically with VMT fees. It emphasizes the financing potential of VMT fees rather than congestion management capabilities and is primarily concerned with the system-wide application of pricing as opposed to facility specific or sub-areas. It is recognized that, however, facility specific or sub-area pricing strategies are the building blocks in establishing a system wide pricing program. An expanded list of potential regional pricing options is beyond the scope and intent of this paper. The following provides a broad description of VMT fee pricing method (s) and variations. The distinction between different aspects of pricing methods will help to critically evaluate the existing system, delineate strategic objectives, and differentiate between an ideal and the practical reality.

#### **VMT Fee - An Alternative to the Existing Fuel Based System?**

A VMT fee is pricing based on distance traveled. Its rate structure may be a flat per mile charge or vary with tempo and the rhythm of traffic. Under true distance-based pricing, the charge would be related to the actual distance traveled as well as to the location and time of day. The rate may vary with the type or capacity of the roadway and the vehicle type, vehicle age, weight/axle, or emission category. VMT is suggested for exacting fees for road use as well as compensating or minimizing transportation externalities. It is a good measure for overall road use and safety index when compared to fuel taxes, since fuel use is roughly related to miles driven due to differences in auto efficiency. On the other hand, VMT would be a rough estimate of fuel use impact and only partially related to emissions, because of cold starts, evaporation, etc.

Major factors in evaluating VMT pricing involve the magnitude of application both in terms of fee structure and geographical area as well as strategic objectives, methods of calculation, and the frequency of collection. The appropriate VMT fee levels would depend entirely on strategic objectives to be achieved. The fee structure could be set to generate a specified amount of revenue which could include infrastructure maintenance, operations, and capacity improvements, capture transportation external costs, and perhaps replacing other taxes such as fuel tax or transportation sales tax. This is the use of VMT primarily as a transportation financing mechanism.

On the other hand, the fee could be assessed to deter or alter trips or provide incentives for increased use of low emission vehicles. This is the use of VMT as a congestion and behavioral management tool, including air quality. In this case a higher fee structure is potentially required. The financing aspect requires calculating the total cost of developing and maintaining an advanced and efficient transportation system divided by congested and non-congested VMT proportionately. The demand management aspect requires identifying the threshold level which triggers travel decision or vehicle purchase and set the fee accordingly. The ideal method is the scheduled fee structure which differentiates between congested VMT and non-congested VMT as well as vehicle characteristics. The method could further differentiate between light duty and heavy duty vehicles such as buses, trucks, and private auto based on weight or axle.

The VMT fee system is flexible and versatile. The revenue generating objective and congestion management or air quality objectives could be integrated, but that requires a sophisticated variable fee system with complex implementation procedure. The VMT pricing system can be weighted to allow for additional variations to be introduced in addressing certain socioeconomic, technological and demographic, and land use concerns. For example, this could include a discounted rate for certain types of vehicles - - such as electric, equitable rates for low income travelers, discounted or exemption of a portion of VMT fee to provide for lifeline level of travel, differential rates based on types of trip (i.e. for private and business travel), fees scheduled based on household characteristics or household basis rather than vehicle basis, and surcharges on a very high levels of annual VMT.

The implementation of differential VMT fees on a system-wide or regional basis becomes increasingly more complex to administer as drivers travel through different jurisdictions, moving in and out of different facilities at different times, and is further complicated by out-of-state and international travelers, recreational travelers and vehicles, and interstate movement of goods and trucks.

The frequency of VMT fee collection is a critical factor in its utility and achieving its objectives. An annual or periodic payment schedule could be problematic. Such arrangement may not influence the day-to-day travel decisions, minimizing the effectiveness of the method in curbing VMT. The accumulated fees could amount to large annual or quarterly tabs, requiring budgetary discipline on the part of households and individuals. This approach may increase the rate of default and fraud, putting a burden on households, particularly those having lower incomes. To avoid this problem, the fee increments should be charged in a same manner as a fuel tax. This implies a potentially complex collection scheme involving real time reading of odometer, perhaps each time a vehicle is fueled. A frequent payment schedule, however, would likely to have a more direct effect on travel behavior. The potential for fraud and odometer rollbacks, however, still exist and may increase with higher fee structure, requiring more sophisticated on-board equipment.

The cost of implementing the VMT fee method would, in large part, depend on whether the program would administratively use existing programs such as vehicle registration or inspection, or a new program designed specifically to collect, monitor, and enforce the VMT pricing system. In addition, program designs requiring new technologies (on board monitors, at-the-pump readers, etc.) would be more costly but potentially more accurate than other options. (Note that this paper is primarily concerned with the system wide or regional application of VMT which is by far more complicated than facility specific congestion pricing).

### **VMT Variations**

There are many variations of the vehicle miles traveled (VMT) fee concept. The following is a brief discussion of some of the more pronounced variations (4).

**VMT/Flat Fee:** In this case, vehicle owners would be charged a flat fee per mile of roadway use. The rate may vary by vehicle type such as private auto vs. commercial vehicles, but would not involve differential or weighted fee schedule, based on vehicle age, emission, facility, or congestion.

A primary emphasis would be on generating a targeted revenue level or substituting certain taxes such as motor fuel or sales tax. The rate is normally modest, since the flat fee does not differentiate between congested and non-congested facilities or urban and rural areas. High rate schedules would raise the issue of equity and inproportionate charges relative to roadway capacity use. While some limited impacts on congestion and air quality might result, the main focus would be to finance transportation system maintenance and operation as well as new investments.

**VMT/Flat Fee with “Cold Start”:** This concept is conceived to reduce the total number of trips to benefit air quality, since “cold start” is a major factor in air pollution. In this case the fee is additive, assessed on a per mile and per-start basis. The electronic devices would need to be fairly sophisticated in order to register vehicle starts or idle states as well as miles traveled.

**VMT Differential Pricing:** This concept of VMT congestion pricing is relatively simple. Vehicles would be required to pay a user charge which could be set to vary by time of day, vehicle category, type of facility, and other variables. The strategic objective is to alter travel demand by pricing congested roadway networks while providing an equitable fee structure for those outside the congested areas. the VMT fee is flexible and could include socioeconomic, land use and demographic factors. This method is likely to generate a significant amount of revenue as well. The result of pricing may be a shift to other modes of transportation and travel options, therefore, requiring a total approach to transportation system investment decisions.

As the scale and magnitude of the congestion pricing strategies increase, its demand management potential improves. A regional or system-wide pricing approach is also a more viable financing alternative. However, the complexity and technological requirements become more challenging with the magnitude of the pricing strategy.

In general, there are two differentiable levels of congestion pricing. The regional or system-wide application and facility specific or sub-area application. The former is technologically problematic and involves complex administrative and implementation requirements. The latter is potentially viable depending on the facility and area characteristics and could take a variety of forms. The more familiar congestion pricing schemes include area (ring) pricing, gateway or “choke” points, full freeway system, HOV buy-in (HOT lanes). Some of these concepts incorporate the use of VMT.

The concept of *sub-area/ring pricing* is relatively simple. All roads leading to a particular zone, ( i.e. downtown), would be protected electronically or by other means and tolled based on variables such as the time of the day, vehicle characteristics and category. If the geographic area is irregular and involves a large number of entrances, it would present a unique challenge. This may involve both freeways and local streets and a large number of toll collection facilities. The fee structure of the ring pricing does not normally involve the miles traveled within the protected area.

The *gateway or choke points pricing* option is best suited for areas with limited points of access due to topography and natural settings or man-made structures. San Francisco, for example, which is bounded by water on three

sides and has limited number of bridge crossings might be a suitable area for this concept. It would be difficult to locate a specific gateways in the greater Los Angeles region. The problem with the gateway toll concept is that the limited number of toll collection locations requires concentrated tolls which would be higher than those under a full freeway pricing scenario. As a result, there is potential negative impact on local arterial due to traffic diversions around the toll locations.

One of the more practical programs in light of technological considerations is ***pricing the full freeway system***. Freeways normally carry a significant portion of total vehicle miles of travel and are recognized as the primary focal point of congestion. Establishing road pricing on the freeway system is an attempt to focus road use charges in the most congested location and dampen demand on the system. This can be done in a variety of ways. A variable fee structure can be applied depending on the time of day, congested sections or miles traveled on the system using an open or closed tolling mechanisms covering all ramps along the freeway system. The technology requirement is greatly simplified given the limited-access nature of the freeway system. One of the negative impacts of freeway congestion pricing would be on local arterial due to traffic diversion. Extending the pricing to non-limited access local roads would increase the technological complexity significantly with exponential increase in the capital costs of an electronic toll system. As the scope of the congestion pricing broadens to include more routes within a region, the strategy would become less focused and begin to approach the basic VMT fee concept.

The ***HOV buy-In concept*** permits the use of HOV lanes by single-occupant vehicles for a toll. The fee could vary based on time of day, miles traveled, and congestion levels which is collected electronically. The intent is to price the HOV lane at a level which would maintain a maximum traffic flow and optimize the total available capacity of the freeway system. The effectiveness of this strategy depends on available capacity or creating excess capacity in HOV lanes (i.e., by changing the car pool ratio). The concept would provide some potential congestion relief, but the trade-off is probably short term and holds until all excess capacity is effectively used up. Interestingly, the concept of High Occupancy Toll (HOT) lanes is inherently contradictory. On one hand, ridesharing is encouraged through HOV lanes, while on the other hand, single occupant vehicles can gain access to the same lanes by paying a premium price, negating the incentives provided by the HOV lanes. Nevertheless, given the growing demand and increasing vehicle registrations, under certain circumstances, the HOT lanes' experience could be positive, particularly in providing a foot hold in the broader application of a road pricing system.

**Emissions Differential Pricing:** The concept focuses on the vehicle emissions and the air quality. Vehicles would be classified based on type, age and nominal emission level. The VMT fee could vary based on these classifications. The strategic objective is to provide incentives to use low emission vehicles and discourage those contributing the maximum to air pollution through pricing based on emissions-differential per mile of travel. The higher the emission rates the greater the emission fee. The longer the trip the higher the cost of travel. The VMT/emission concept is flexible and could incorporate features to improve its effectiveness in achieving air quality objectives such as a coupon program to be used for transit fares, emission control repair, etc. Similarly, the features could include annualized exemption for some trips or life line mileage exemptions to protect certain demographic groups (i.e. low income from excess impact of VMT fee).

Generally, this concept is not so much about transportation system user fees, but on vehicle user fees, although the two are interconnected. The fee is assessed mainly based on the classes and characteristics of the vehicles, rather than the use of transportation facility. This could lead to a problem of disconnecting the emission fee from the transportation system user similar to gas tax. The result is that as the vehicles using the system become cleaner and less polluting the revenue collections decrease. This effect could be mitigated by incorporating emission fees into other VMT pricing variations, such as congestion pricing.

**VMT/Emissions Differential Pricing at the Pump:** This concept attempts to provide potential solutions to the technological difficulties presented by VMT fee collection. The vehicle characteristics such as make, model and age, and perhaps other features are identified electronically and the proper VMT fee charge is calculated. Assuming all vehicles were equipped properly with a tamper-proof electronic chip, the fee could be collected as part of gasoline purchase. All vehicles would have a nominal fuel efficiency rating and the emissions category would be determined automatically at the pump. Additional VMT surcharges computed are based on the gallons of gasoline intake.

The advantage of this concept is that without relying on an electronic odometer, a reasonable approximation of VMT per gallons of fuel sold could be made. The fee would be collected with the purchase of the fuel at the gas station. The fee rate could be based on the nominal computed VMT and the vehicle characteristics --emission, age, etc. For example, if the VMT/emission fee is set at \$0.05 per mile and a MPG of 20 for a particular vehicle, the equivalent VMT fee per gallon would be \$1.00.

It is still necessary, however, to equip all vehicles within the region with electronically readable, tamper-proof vehicle identification system. The

vehicles outside the region which may not be equipped with this system could possibly be accommodated by increasing the face value of the gasoline tax at the pump. This means permitting vehicles within the region, equipped with the appropriate “chips” to get discounted rates at the time of purchasing fuel. However, there is a practical limit to the extent that this mechanism could be effectively utilized.

**Congestion Pricing/Emissions Differential:** Technically, all of the congestion pricing options discussed earlier could incorporate emissions differential pricing with different degrees of complexity. A variable fee can be enforced per mile depending on the emissions characteristics of a vehicle, for example, the pricing rate on a full freeway pricing could vary from \$.05 to \$.20 per mile. It would appear that emissions differential pricing could particularly fit well within the VMT fee system, although it would present additional enforcement challenges and fraud prevention mechanisms.

## **Viable Pricing Technologies**

Before analyzing potential pricing scenarios based on the categories of VMT variations discussed above, it is useful to broadly define the state of technology alternatives. This would help delineate practical pricing strategies in relation to most realistic implementing technologies and in conceptualizing the system architecture of the VMT fee system. In this study, implementation methods that would complement or potentially substitute the current fuel-based financing system as well as those that minimize the use of traditional toll collection were sought. The following discussion includes excerpts from a recent study on potential tolling technologies (5). A detailed review is beyond the scope of this paper.

The pricing system would primarily use an electronic toll collection system (ETC) often referred to as Automatic Vehicle Identification (AVI) or Electronic Toll and Traffic Management (ETTM). In essence, the concept involves establishment of accounts (usually pre-paid) after which a vehicle is equipped with a transponder device, or tag. As the vehicle passes through a toll plaza, or a fully electronic tolling zone, the reader identifies the account and the appropriate toll amount is deducted from the balance or recorded and billed later under a post-payment system. There is no need for the vehicle to stop, and the entire transaction processing can be essentially transparent to the user of the system.

Generally, there are two overall system concepts for electronic toll collection. Dedicated Short-Range Communications (DSRC); and Global Positioning System (GPS)/Ground Station Module(GSM) Type System. The GSM/GPS systems have recently been developed and would have the potential

application on widespread road pricing. Virtually all existing ETC systems throughout the world currently fall within the DSRC system which basically involves direct vehicle to roadside communication. The vehicle is equipped with a transponder device and an antenna would be provided at each reading location, either in a toll lane, on the side of a ramp, or over a mainline section, etc. Each interrogator location would also be equipped with a reader unit, which decodes information obtained from the transponder and ultimately communicates through a back-end computer system for account processing and record storage. There are different generic levels of complexity within the DSRC, ETC concepts. All the new ETC systems now being planned provide Read-Write capability. However, there is a rapid movement toward more sophisticated transponders which will permit a “smart card” interface which would be preferred mode of operation in the U.S.

If tolls were applied on the existing freeway system, two generic options could be considered: a closed ETC system and an open ETC system. Under the open system, ETC equipment would be mounted on overpasses, sign bridges or newly constructed gantries above the existing travel lanes on mainline sections. It might be possible to exclude HOV lanes, if HOV traffic was not to be priced. As the vehicles passed through the mainline tolling zones, the appropriate toll charge would be assessed for that particular segment. The primary disadvantage of this system is that tolling zones would need to be established at virtually every mainline segment in the freeway system, or at least that portion of it to be subjected to pricing. Open ETC tolling would tend to be more applicable on a more limited pricing application, or where pricing was used on non-limited access facilities such as major arterial.

The typical closed ETC system would involve implementation of reader devices on all entry and exit ramps to the system. Employing a transponder with read-write capability, as the vehicle entered the freeway system, the point of entry and other information would be written on the transponder. As the vehicle exited at another interchange, the appropriate toll charge would be computed based on the total freeway distance traveled, the time of day and any peak pricing zones which might have been passed through during the trip. Under the closed system, it would not be necessary to have mainline tolling locations, except at the freeway endpoint and a few other isolated locations. The entire freeway system could, to some extent, be considered a “closed system” if all ramps at all interchanges were appropriately equipped. The close system is much more simpler and reliable, if the toll structure to be employed is to vary by vehicle size or classification. Also, enforcement is much more difficult at high speeds under an open road environment, although many ETC manufacturers claim to have developed technologies which can meet this challenge.

Under the GPS/GSM concept a “virtual” toll plaza concept would be used in connection with global positioning system (GPS) satellite and cellular communications. Each vehicle would be equipped with a sophisticated GPS/GSM on-board. In this case, a tolling zone is simply identified by its coordinates on a regional grid system. Nothing is actually done to the road itself and no equipment is installed at interchanges, on mainline gantries, etc. When the on-board GPS identified the vehicle as passing through this “virtual plaza”, the appropriate toll charge would be accumulated in the on-board device. The GPS/GSM concept is appealing by virtue of the fact that no equipment would need to be installed on the massive freeway or roadway system. It is particularly attractive if road pricing were to be extended to non-limited access facilities such as major arterial. However, it presents two major problems which will be difficult to overcome. First of all, enforcement is particularly difficult since all of the revenue collection takes place in on-board devices. Without prescribed electronic toll locations, enforcement becomes more of the random process and subject to potential widespread abuse and fraud. perhaps more importantly is the cost associated with GPS/GSM system which is estimated about \$500 per vehicle. While relatively little equipment would be needed beyond the on-board devices, the cost to equip vehicles statewide or in certain regions will be extremely high. By contrast, the equipment cost to install a DSRC is about 10 percent of the cost of the GPS/GSM concept.

### **Technology Options and Pricing Strategies**

Clearly, alternative pricing options such as those discussed previously would require different types or degree of technological capabilities and sophistication. As indicated earlier, the feasibility and desirability of substituting fuel tax with taxation of vehicle miles traveled (or any other methods) is, in part, dependent on the technological capability of measuring VMT on a regional scale (beyond a facility). Equally important are the effectiveness of the VMT fee in generating revenues or satisfying other strategic objectives as well as the difficulty and cost-effectiveness of implementing such a system. Regardless of the technology option and the pricing strategy, it is clear that the transformation has to take place incrementally with the existing fuel tax structure in place, even in the long term, until such time as a complete transformation may be feasible.

The general description of pricing technologies presented above indicates that the current technological capabilities concerning travel measurement vary widely in accuracy and degree of automation. The current capability along with realistic and foreseen technology improvement and changes would provide certain parameters for defining pricing strategy as well as its scale and magnitude. The strategic objectives and priority would, however, need to

be defined in relation to the purpose of pricing such as financing structure, congestion management or air quality improvements. These strategic objectives are not mutually exclusive and require careful assessment and evaluation.

Given the low and high technology options, there seem to be two basic approaches. A minimum technology option would require a tamper-proof electronic chip to store basic information about the vehicle. All vehicles, including passenger and commercial vehicles, would be assigned a nominal fuel efficiency rating based on vehicle type. An estimate of VMT would be calculated between fill-ups, with the total tax collected being determined by mpg rating for that particular vehicle, including surcharges for emission rates. This approach is referred to as VMT tax proxy and requires sophisticated technology, both on-board the vehicle and at the fuel pump. A more sophisticated option would require an electronic transponder with reader devices stationed at all state border crossings, or in the case of the freeway option at all freeway ramps, to measure and report mileage accumulated within the priced areas.

From a purely technological perspective, several basic conclusions can be drawn. As far as the access controlled portion of the transportation network is concerned, the basic technology to implement the VMT fee concept does exist, although it is not well refined and would require significant initial investment. It seems, for example, that the typical closed ETC system is a suitable technology for VMT pricing in a full freeway system. The application would involve implementation of reader devices on all entry and exit ramps to enclose the freeway system or the priced segment of the freeway. The appropriate toll charges would be computed based on the total freeway distance traveled and according to any peak pricing zones or vehicle classification. The traditional ETC system is relatively reliable and cost effective.

Accommodating infrequent users or visitors to the area would be problematic. There are at least two options available. Providing conveniently located courtesy stations may allow visitors to open a temporary account. Alternatively, drivers without accounts may be handled through a video photo-tracing system. This system can be part of the enforcement process that is incorporated in the most existing ETC operations. The issue of internal and external travelers within the pricing boundary or region is a serious challenge to feasibility of transportation pricing which requires further administrative and technological solutions.

The expansion of the VMT toll concept to non-limited access facilities and on an area wide basis is technologically problematic. In the longer term, the open ETC system, particularly GSM/GPS systems, have potential application

on a widespread road pricing. The global positioning and cellular communication system is under consideration in some other countries (i.e. Germany). The system creates a virtual tolling zone on a regional grid system with no equipment installed on the massive freeway system. Assuming that difficulties associated with the GSM/GPS systems implementation are resolved, the concept appears ideal for regional VMT measurement and assessment.

In the near future, given foreseeable technological capability, the application of the VMT concept appears most feasible on a facility by facility basis rather than a network of an integrated roadways. This is not necessarily an obstacle, since a comprehensive system-wide application is neither desirable nor practical. The implementation of such a massive system is cost-prohibitive and technologically challenging. The risk associated with a holistic approach and the nature of policy development implies that a transition to a pricing system can only progress in small steps. VMT pricing represents a substantial change from current practices, therefore, taking small but manageable steps is necessary. Further, a selective and incremental approach provides empirical knowledge on the intricacies of implementing the VMT concept which otherwise would be a matter of trial and error. This approach would also provide the opportunity for public education and behavioral adaptation to a new pricing system.

It is important to differentiate between demonstration and ultimate implementation. At this level of study, it would appear logical to evaluate VMT pricing based on an ultimate implementation concept. It is obviously necessary to identify demonstration projects which would precede the potential system application.

The successful implementation of VMT pricing system requires a viable technology(s) capable of minimizing abuse and fraud of the system, including comprehensive and consistent enforcement. This aspect of the electronic toll collection devices requires further refinement and development. The feasibility of any technology is ultimately depends on how effectively it can deal with this issue.

### **The Nature of the Process - Non-Technology Issues**

The restructuring of the existing transportation financing system can only mean that the transformed system would simply be better and more effective. This criteria should serve as a consistent background against which competing alternatives are assessed and to generate explanation at various levels. Measuring the effectiveness involves a wide range of variables and complicated issues. The feasibility of the VMT pricing system and transition from fuel-based financing to a user fee system goes beyond technology.

Technology is only a medium through which the strategic objective of transportation pricing can be more effectively realized. There are complex socioeconomic, political, institutional, geographic equity, and administrative issues among others that require significant attention. Without resolving these issues and defining a workable framework within which the views and interest of transportation community are brought into a common process, essential financing reform and establishment of a viable pricing system will not be achieved.

A variety of existing institutions could implement transportation pricing projects on specified facilities or bridges. Systemwide pricing throughout a region would be much more difficult, requiring a complex administrative and interjurisdictional arrangements. The state would become a suitable institution to administer a multi regional or a statewide pricing system, particularly on the state highway network. A concerted effort on the part of the state and regional agencies is essential to establish a process through which institutional forms and system architecture of the potential future pricing system would begin to take shape.

## CHAPTER IV

### Scenario Analysis and Evaluation

#### Alternative Scenarios

The focus of this study is the feasibility of VMT pricing system in substituting or complementing the existing fuel-based tax system. Therefore, the process of identifying scenarios becomes somewhat more defined. As reflected throughout the discussion, there are many basic different possibilities and factors that could effect surface transportation financing. The report emphasizes those factors that seem to be significantly influencing the potential future directions of surface transportation funding or likely to present unique challenges, particularly in California.

It is also important to note that evaluation of certain factors, such as rate of technological development and economic influences or potential changes in the national as well as state policy, are difficult and speculative. While these factors could significantly influence VMT evaluation processes, ( i.e., penetration of alternative fuels or vehicle fuel efficiency), their policy and political processes are considered external to the evaluation framework.

Having differentiated between public policy developmental processes and their potential impact, several factors appear instrumental in evaluating transportation financing structure.

- Rate of penetration of alternative fuels and vehicles
- Type of alternative fuels
- CAFE standards and vehicle fuel efficiency
- Advances in large scale automated vehicle monitoring and control technology to measure VMT.
- State and federal programs affecting alternative fuels, fuel economy and transportation financing.
- State and federal laws and regulations concerning energy and air quality.
- State and federal budgetary practices, preemptive priority funding, and publicly approved financing measures affecting fuel tax revenue in specific and transportation revenues in general.

- Rate of increase in transportation costs and investment needs.
- Rate of growth in vehicle registration, VMT, and level of congestion.
- Major organizational and administrative reforms in surface transportation administration and at the federal, state, and regional levels (“true devolution”).

Transportation financing is sensitive to and conditioned by many of these factors. Consequently, financing structures and policies must be capable of dealing with alternative patterns that are shaped by the confluence of these factors. The current financing system and alternative methods of generating revenues have their own strengths and weaknesses with different degree of responsiveness to above variables. Striving for the optimum rather than absolute policy decisions, the following principal scenario is selected for further analysis:

- Implementation of VMT fee in full freeway system.

This is a limited application of VMT pricing. The scenario excludes local roads and non-limited access facilities. This approach seems to provide a more realistic level for evaluating the feasibility of VMT pricing system. As concluded earlier, the financing system must be responsive to future scenarios that may differ from each other based on the influence of above mentioned factors. Some of these factors are quantifiable and have direct impact on the feasibility of a pricing program. Consequently, the principal scenario will be analyzed in light of factors that have measurable impact on the VMT financing system viability. The following factors are selected as primary variables in the evaluation process, without excluding the implications of other secondary factors:

- Penetration of alternative fuels and vehicles by type;
- Vehicle fuel efficiency and CAFE standards;
- VMT growth and technological availability for measuring VMT on a continuous or frequent but periodic basis.

The VMT fee analysis would be based on a base case VMT and compared against or evaluated in conjunction with the current fuel-based financing system, particularly in terms of generating revenue. Other factors listed earlier would also be of interest and will be evaluated on a less formal basis. These would include:

- State and federal programs and practices affecting transportation financing and investments;
- Major reforms in surface transportation investment at the federal, state, and regional level -- “true devolution”.

There are several reasons why transportation policies, practices, and reforms may impact the feasibility of VMT financing system. These policies may, for example, reflect changes in the energy consumption, vehicle emissions, VMT growth, alternative fuel mandates, CAFE standards, budgetary and programming practices, as well as potential requirement for transportation investment criteria.

### **Setting the Strategic Objectives**

As indicated earlier, it is critically important to clearly underline the strategic objectives of a pricing program before evaluating potential pricing options. This would provide clear direction and help define the analytic framework and evaluation criteria in order to prioritize market based strategies in light of stated objectives. Whether the objective is congestion, mobility, air quality, or revenue generation, they must be identified, evaluated, and prioritized. The priority of these strategic objectives would shape justifications (public and political) of pricing strategy as well as the evaluation criteria. For example, pricing policy evaluation may differ widely depending on whether objectives are defined as fighting congestion or establishing a new sources of revenue and financing system.

This study assigns strategic priority to new sources of revenue, including financing reform, in establishing the pricing program. This is intended as the primary objective and is consistent with mobility and safety of the transportation system. Other strategic objectives such as air quality, congestion, and energy conservation are important and are considered in evaluating the overall feasibility of the VMT pricing method. Environmental related fees designed to achieve clean air or demand management objectives can be implemented within the same process, for example, as surcharge over the base fee. All of these strategic objectives are interrelated and mutually supportive. The primary policy intent is to establish a more direct relationship between the user of the transportation facilities and financing of the transportation system in the context of stable and predictable revenue source which is equitable and market responsive.

The strategic priority of financing objectives becomes further evident in any large scale user fee system. As discussed before, as the scale of a pricing program expands from a single facility or sub-area into a regional and statewide system, its revenue generating potential would be enhanced

significantly. A large scale pricing system would benefit air quality and congestion, particularly if a differential fee system is applied .

It is important to note that setting strategic priorities is an involved and multi layered process. This feedback process would require; a) defining the functional and system view of the future intermodal transportation system; b) defining the role, responsibility, and accountability of the state and regions based on the stated transportation system objectives; and c) identifying revenue sources and mechanism, including new sources as well as determining allocation and investment strategies which would be consistent with “a” and “b”. The lack of effectively articulating on these layers of strategic objectives have created vacuum for properly defining and meeting the needs of the transportation system . The task of articulating on this policy developmental process is beyond the scope and purpose of this study.

### **Trucks and Goods Movements**

The analysis and evaluation processes in this report focus on light duty vehicles. The intent is to discuss significant factors concerning transportation financing today and demonstrate feasibility of alternative policy options and revenue sources. It was recognized that to be analytically objective and equitable in the evaluation process, a more detailed discussion of the functional role and classifications of trucks as well as their impacts should be presented. Such detailed discussions was beyond the scope of this study. However, the lack of such discussion does not undermine the analytic integrity and evaluation framework presented in this report. The pricing concept and methods applied are equally applicable to heavy duty trucks and buses. Ideally, cost allocations and pricing analysis would be more appropriately based on vehicle classes categorized on the basis of weight and axle type rather than by broad generic categories of light duty and heavy duty vehicles. It is recommended that a focused evaluation of the VMT application for the truck category be conducted based on the method, framework and assumptions used in this report.

In a nut shell, trucks and buses, from capital and operational view, impose much higher impact on facility design and wear and tear of the roadway network. Consequently, there are suggestions as to higher fees for trucks using transportation facilities. On the other hand, trucks play a significant economic function in terms of movement of goods and services. The impact of higher fee for trucks may well be reflected in a variety of other market places, namely in the value of goods and services and eventually in the cost of living. There are a series of macroeconomics as well as microeconomics transactions that might follow by changes in the relation of production or the political economy. There could be a problem of double counting and hidden charges, since increased commercial fees may not be absorbed by the truck industry.

Setting user fee for both light and heavy duty vehicle must be equitable and reflective of the use of the facility and the cost of providing transportation services (internal cost). Complicating the issue is that within the category of heavy duty trucks, there are considerable weights variations. The VMT, use of the roadway system, associated with different weight categories should be reflected in the pricing analysis. The external factors such as economics and social goods should also be considered, but in a separate process and mitigated as appropriate.

## **Evaluation Framework**

Having defined financing as the primary strategic objective, the viability of the VMT pricing system can be measured, in most part, as to whether it can effectively and equitably generate the amount of revenue needed at a reasonable fee. The need is based on current and future assessments to pay for the cost of maintaining and developing an advanced transportation system which would support California's mobility and economic infrastructure needs.

If we were to consider congestion or air quality as strategic objectives, the VMT fee threshold would have been calculated differently and in a manner to alter trips or provide incentive for low emission vehicles. Given the technological capability and availability, a balance may be struck through the introduction of a variable fee which would differentiate between the congested and non-congested VMT as well as vehicle characteristics. In that case a surcharge can be calculated for the use of particular facility, level of congestion, or vehicle type.

Exhibit 1 outlines selected scenarios to be evaluated or discussed under the stated policy directions. Each of these scenarios will be discussed and analyzed in variable degrees, along the indicated policy directions. The base case scenario underlines the current system capabilities in generating revenues and meeting transportation investment needs. It is used as a basis for comparing alternative scenarios and as an option for continued and improved fuel-based financing system.

EXHIBIT 1  
Scenario Evaluation Framework

<u>Scenarios</u>	<u>Policy Directions</u>		
	Status Quo	Improving Existing System	Transition to VMT System
Full VMT	Discuss		Evaluate
Combined VMT and Fuel Tax	Discuss		Evaluate
Penetration of Alternative Fuels	Discuss	Discuss	
High Vehicle Fuel Efficiency	Discuss	Discuss	
Organizational and Program Reform			
Base Case - Current Fuel Tax	Discuss	Discuss	Evaluate

In addition, it is useful to underline basic policy directions that are available to transportation decision makers concerning transportation financing and funding options,

- Maintain the status quo with no fundamental change in transportation fuel-based finance structure and practices. This is the base case for comparative policy analysis;
- Substantially improve the existing fuel-based tax system. This would involve turning the fuel tax receipts into a dedicated account through minimizing diversion to other public policy objectives, establishing equivalent taxation for alternative fuels and vehicle economy, and reforming the funding allocation process by setting effective investment strategies.
- Incremental introduction of VMT measurement and assessment. This would require an extensive commitment to demonstration programs, development of a system architecture for the VMT pricing system, technology improvement for measuring VMT, and establishment of a compact between the state, region and the private industries in resolving institutional, administrative and implementation issues involving a new system.

## **Analysis of Surface Transportation Financing**

The next section provides an analysis and discussion of the surface transportation financing under each of six scenarios. As reflected earlier, there are instrumental factors in the process of transforming the existing system. These factors are often difficult to predict or quantify, such as technological advancement, public policy changes, and uncertainties.

In the following sections, each of the selected scenarios will be defined in quantitative terms, to the extent possible, and in terms of the potential level of revenues available for surface transportation programs. Both the revenue loss from fuel displacement and potential revenue generated from alternative sources are considered. This is intended to provide examples of potential impacts on revenues for each scenario. The values primarily represent a range or magnitude of possible impacts rather than specific targets. The projections, nevertheless, are intended to be consistent with likely developments in future transportation programs and highway financing.

Before presenting a detailed analysis, it will suffice to state that policy decisions that will promote appropriate mix of VMT fee and fuel tax are desirable decisions in the process of developing an ideal transportation financing system.

### **Base Case Scenario - the existing system**

The base case scenario, involving efforts to “muddle through” with no basic change in policy, is used as a basis for comparing and evaluating the alternative scenarios. It must be noted that there are uncertainties in setting the existing system in proper context for the purpose of the evaluation process. Transportation is undergoing major policy debate and changes. The outcome of ISTEA reauthorization (NEXTEA) and other state and national initiatives are unknown at this time. To be analytically correct, it is important to recognize that some of the systemic problems underlined by the critic of the existing system do not appear to be endemic to and are not the result of the internal deficiency in the current fuel-based tax system. The difficulties are also in the political process by which the need, interest, role, and responsibilities of transportation system and stakeholders are defined and agreed upon.

**Table 1**  
**Future Needs Assessment**  
**20-Year non-Capital and Capital Needs**

	Estimated Existing Annual Need	<u>Estimated 20 Year Need (billions)</u>	
		Current dollars	Escalated dollars
<u>Non Capital Needs</u>			
State Highway Operations and Maintenance	\$ 0.69	\$13.90	\$25.35
Tort Liability	\$ 0.04	\$0.80	\$1.10
State Supported Intercity Rail Operations	\$ 0.05		
Local Streets and Roads Ops and Maintenance	\$ 0.50	\$10.00	\$13.60
Public Transit (bus/rail) Ops and Maintenance	\$ 3.07	\$61.30	\$83.40
Sub Total - Non Capital	\$4.35	\$86.91	\$125.05
<u>Capital Needs</u>			
State Highway and Modal Capacity Improvements (typical STIP projects) (Unconstrained estimates)	\$6.10	\$122.30	\$165.81
State Supported Intercity Rail	\$0.02	\$0.38	\$0.54
State Highway Operation/safety Improvements (typical SHOPP projects)	\$0.38	\$7.60	\$10.33
State Highway and Bridge Rehabilitation Improvements	\$0.43	\$8.66	\$11.69
Local Streets and Roads --Rehabilitation	\$0.89	\$17.90	\$24.20
Public Transit (bus and rail)--Rehabilitation	\$1.79	\$35.80	\$48.70
Aviation (primary/commercial,reliever & general aviation airports - 10 year totals only)	\$0.57	\$5.69	\$6.52
High Speed Rail - Capital Only	\$0.00	\$20.40	\$37.00
Sub Total - Capital	\$10.18	\$218.73	\$304.79
Grand Total - Capital and non Capital	\$14.53	\$305.64	\$429.84

assumption: some of the 20 year time frames differ in that beginning and ending years may differ.

The exiting system is likely to perform much more effectively if procedural and methodological reforms in transportation investment strategies and public policy practices are actually realized. Attributing the effect of political and policy short comings to the structural problem of the existing fuel based system is misleading. This would undermine the objective evaluation and comparative analysis. It is, therefore, important to separate structural problems and procedural problems associated with the existing financing system.

To assess the future transportation needs as a reference, a quick exercise was performed to determine the level of funding necessary for maintaining California's advance transportation system. The estimates are rough and based on no defined strategic objectives. The numbers are primarily derived from Transportation Consensus Project, Caltrans Transportation System Improvement Programs, and Regional Transportation Plans. Table 1, above, summarizes the 20-year funding needs by category. The table serves as the basis for the level of revenue needed for future transportation system and for comparison of new revenue sources to the continuation of the current revenue structure.

Table 2 summarizes the existing state surface transportation revenue sources.

<p style="text-align: center;"><b>Table 2</b>  <b>Annual State Transportation Revenue Receipts</b>  <b>Estimated/billions</b></p>			
	<u>Federal</u>	<u>State</u>	<u>Total</u>
Motor Fuel			
gasoline	\$1.275	\$1.750	\$3.025
diesel	\$0.225	\$0.240	\$0.465
other (truck weight fee, TP&D, sales tax)		\$0.490	
TOTAL	\$1.500	\$2.480	\$3.98
<p>note - driver license fee, vehicle registration fees, carriers growth receipts, etc.  are not included in this table since they are allocated to programs other than  the state transportation program</p>			

Generally, in order to develop a budget the essential programs and projects necessary to meet the transportation systems needs are determined. Then, the available budget under the existing financing system or the level of overall fees under the alternative user fee approaches are identified. Given the strategic priority of programs and projects, this process will determine the constraint budget and the financial resources for the transportation investment and operating programs.

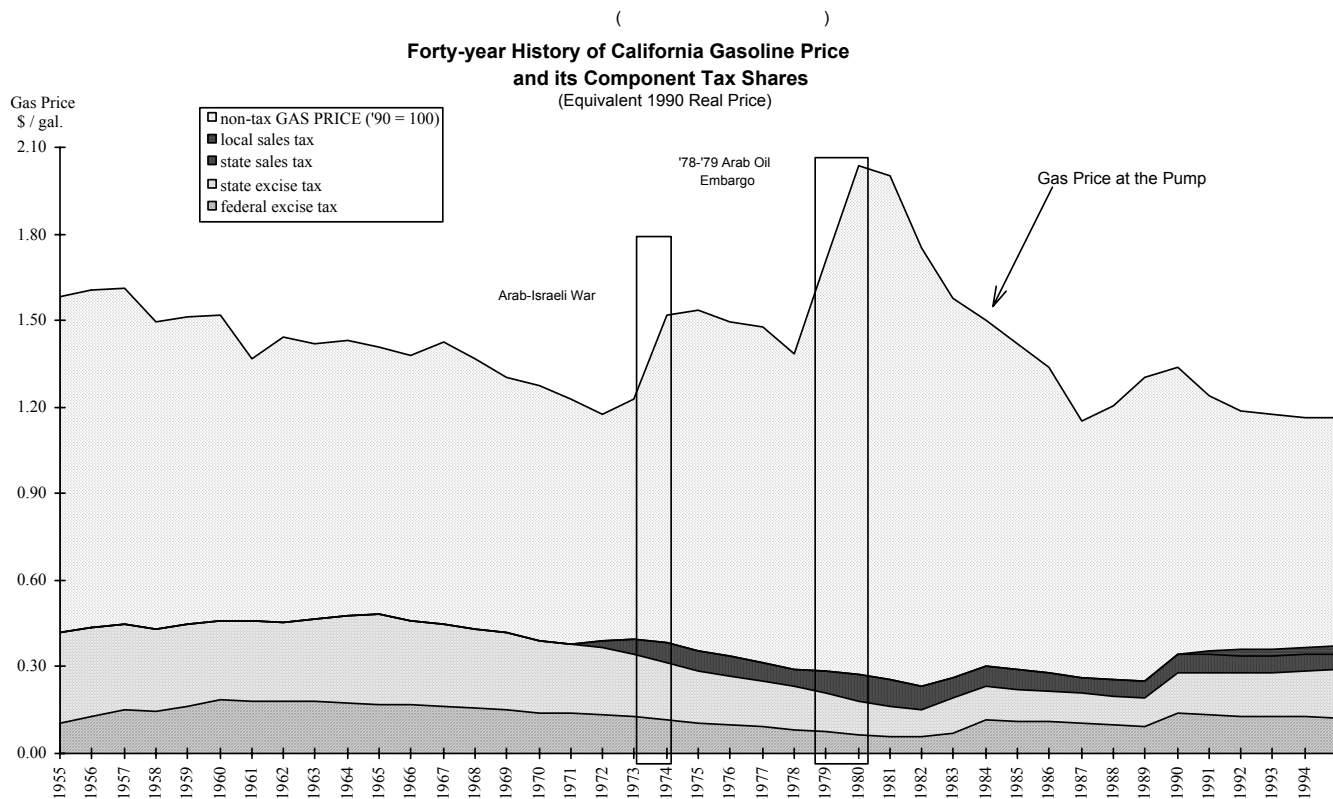
Table 1 indicates that, given the state's transportation system capital and non-capital needs, there is a current deficit of \$8.59 billion in transportation revenues. The short fall for the state highway system amounts to \$3.66 billion.

Table 3 indicates projected revenues from the current 36.4 cents gas tax for the state highway system for 2005 and 2015. Values reflect combined state and federal gas tax, excluding sales tax and any other transportation related revenue sources. The motor fuel taxes account for roughly 85 percent of the total transportation revenues. Assuming that fuel taxes remain constant, the future revenue deficit would get progressively larger.

The projected revenue yield from gas tax receipts provide information about whether the fuel-based revenue source could provide sufficient and responsive revenues as a primary financing source for surface transportation. Assuming that other transportation related taxes or fees remain constant, the projected gas tax receipt is less than projected needs, given its proportionate share (85%) of the state transportation revenue.

<b>Table 3</b> <b>Projected Gas Tax Receipts for</b> <b>State Highway System</b> <b>(billions)</b>			
	96-97	2005	2015
State Gas Tax	\$1.75	\$1.90	\$2.10
Federal Gas Tax	\$1.28	\$1.38	\$1.53
Total Receipts	\$3.03	\$3.28	\$3.63
* assumes %1 average annual increase in gas tax revenue.			

Further, the short fall in fuel gas receipts is exacerbated by the fact that, historically, the rate of fuel consumption has fallen short of the increase in vehicle miles of travel as well as inflation (see figure 1 below). Consequently, the adequacy (in terms of generating revenue) is considered the most important criteria in evaluating VMT pricing as alternative to or augmenting motor fuel taxes. If an equitable range of VMT fee can not provide comparable or greater revenues for the state transportation system, then policy efforts can be focused on alternatives which can meet the needs.



## Alternative Fuels and Vehicles Market Penetration

The introduction of the alternative fuels into California's transportation market has been gradual and, generally, overlooked in the future surface transportation finance. But with an uncertain long-term future for oil supplies and prices as well as market response to federal and state energy and air quality initiatives, alternative fuels may have a more substantial and important role. In light of public and market influences, conserving and diversifying energy resources remains a long term public policy objective.

Largely as a result of environmental regulations and energy legislation, and in spite of less than favorable market conditions, there is a potential for the entrance of an estimated one million alternative fuel vehicles (AFVs) into the California market in the next 7 to 10 years. This could translate to displacement of estimated 513 million gallons of gasoline or \$118,602,000 transportation revenue loss in terms of equivalent gasoline sales.

Table 4 indicates the number of current and projected AFVs in California.

<p style="text-align: center;"><b>Table 4</b>  <b>Current and Projected Number of AFVs in California</b>  <b>(thousands of light duty vehicle)</b></p>			
<u>Fuel Type</u>	1994	2005	2015
Gasoline	21,723	24,740 - 24,754	26,797 - 26,823
Propane	40	45	51
M85	11	159 - 174	262 - 294
CNG	6	235	452
Electric	0.6	594	1709
Total AFVs	57.6	1033 - 1048	2474 - 2506
source: California Energy Commission			

Electric vehicles are expected to show both the largest absolute and percent increase among alternative-fueled vehicles. Growth in this category is primarily driven by government mandates and regulations. The zero-emission vehicles (ZEV) mandates were eased somewhat in 1996, when California Air Resources Board decided to delay the start of its ZEV mandates from model year 1998 to model year 2003. Table 5 reflects taxes applied to sales of motor fuels in California.

Total gasoline demand in California is expected to remain relatively constant due to increase in alternative fuel use, fuel economy increases primarily from technological advances, and switching from gasoline to diesel and alternative fuels for movement of goods. The use of light-duty AFVs is expected to displace 513,000,000 gallons of gasoline per year by 2005. While this may have positive and important effects on air quality by reducing carbon emissions, it could also reduce fuel tax receipts from conventional fuels by \$118,602,000, factoring in the tax differential rates. By 2015 the revenue opportunity loss could potentially reach \$240,561,000.

Table 5 demonstrates the differential state and federal tax rates currently applied to alternative fuels. This reflects a wide margin from no tax for the electricity consumption to \$0.364 tax for conventional fuel.

**Table 5**  
**Taxes Applied to Sales of Highway Motor Fuels in California**  
**(dollars as of mid-1995)**

<u>Fuel</u>	<u>Federal Excise Tax</u>	<u>State Excise Tax</u>	<u>State/Local Sales (average Percent)</u>
M85	0.114	0.09	7.9
CNG	0.0485	0.07	none
Propane/ LNG	0.183	0.06	7.9
Electricity	- - -	- - -	- - -
Gasoline	0.184	0.18	7.9
Diesel	0.244	0.18	7.9

Tables 6 and 7 estimate the amount of gasoline displaced by alternative fuels used in light duty vehicles and the potential revenue loss to surface transportation, considering the differential tax rates. For the purposes of these tables, it is assumed that alternative fuels achieve equal fuel economies when compared to conventional gasoline on an energy consumption basis. It is established that the efficiency of electric vehicle is higher than the conventional vehicle with greater revenue impact. The efficiency aspect of AFVs will be addressed in the fuel economy section.

**Table 6**  
**Projected Light Duty Vehicle Gasoline Displacement**  
**By Alternative Transportation Fuels**  
**(in millions of gallons)**

<u>Fuel</u>	<u>2005</u>	<u>2015</u>
Electricity	312	644
CNG	163	232
M85	7	12
Propane	31	33
Total Alt. Fuels	513	921
Light Duty Vehicle Gasoline Demand with Alt. Fuels	12571	12603
Light Duty Vehicle Gasoline Demand without Alt. Fuels	13084	13524

\* assumes no change in travel demand or fuel prices between the two cases.  
assumes same mpg for EVs and conventional vehicles.

**Table 7**  
**Projected Potential Revenue Loss to Surface Transportation**  
**By Alternative Fuels**

<u>Fuel</u>	Differential Tax Rate compared <u>gas tax (cents)</u>	2005 Revenue <u>Loss</u>	2015 Revenue <u>Loss</u>
M85	0.16	\$1,120,000	\$1,920,000
CNG	0.001	\$163,000	\$232,000
Propane/ LNG	0.121	\$3,751,000	\$3,993,000
Electricity	0.364	\$113,568,000	\$234,416,000
TOTAL		\$118,602,000	\$240,561,000

• does not include sales tax. Assumes fuel tax rates remain constant.

There are a number of major factors which affect the marketing of alternative fuels: the availability of AFVs, the cost of owning and operating AFVs, the number and location of fueling sites, and the price competition between alternative fuels and conventional fuel. The government policy could have a measurable impact on the long term viability of the alternative fuels and factors influencing the marketing of alternative fuels and vehicles. It appears that the introduction of the AFVs in California's transportation energy market will continue at a gradual pace, limited by a variety of market and regulatory uncertainties. In 1994, AFVs collectively amounted to only a small fraction of California's total light duty motor vehicle stock of almost 22 million. But the long term AFVs forecast appears to indicate a steadily higher portion of vehicle stock with considerable potential for revenue loss to surface transportation. The AFVs is expected to grow more rapidly in California compared to nationwide rate of growth, therefore, becoming of more concern in the West than in the South, for example.

The Energy Policy Act requires that AFVs constitute at least 75 percent of federal and state fleet purchase and 90 percent of fuel-provider fleet purchases of light duty vehicles by the year 2000. California's low-emission vehicle regulations require auto makers to sell increasing number of vehicles with much lower emissions, including a sales fraction of zero emission vehicles (ZEV). This requirement is the only current program that is expected to result in a substantial penetration of AFVs in the market. The original regulations mandate that 10 percent of each of the largest manufacturer's light duty sales in California must be ZEVs by 2003. Based on this mandate, the number of light duty ZEVs sold in California could reach 132000 per year (6).

At the same time, continuing progress in reducing new gasoline vehicle emissions is having an important effect on auto industry development and marketing of AFVs. It is suggested that the combination of gasoline reformulation and advances in automotive emission control technology appears to be making the exhaust emission levels required by California's low-emission vehicle standards achievable without relying on the use of alternative fuels. The revenue impact of the cleaner-burning gasoline light-duty vehicles is not known and requires closer evaluation. The impact could be two fold. From one hand, it may slow down the rate of AFVs' introduction into the market, therefore, lowering the gasoline displacement from the market share of alternative fuels. On the other hand, the new generations of gasoline vehicles have a much higher fuel economy when compared to conventional fuels. The net effect, nevertheless, appears negative in terms of reduced revenue (see next section, high vehicle fuel efficiency).

Taxation plays an important role in comparative retail prices of fuels and their revenue generating potential. Potential changes to these fuel tax rates

could alter the comparative outlook for retail fuel prices. There are a myriad of alternative fuels and reformulated gasoline in the market with no common, equivalent tax structure (see table 5). For example, M85 and propane are taxed roughly on an energy-based par with gasoline and diesel. CNG is currently taxed at a much lower rate, about 14 percent of the retail price, and electricity is currently untaxed. It is suggested that partial tax exemptions for ethanol fuels have diverted \$7.1 billion from the Highway Trust Fund (7).

The differential taxation practice is substantially complicating the future fuel tax collection and revenue projection. It appears that non-transportation related policies is shaping the transportation energy pricing structure. This has fragmented policy decisions on fuel taxes and undermined a systematic approach in evaluating proper tax rate for transportation fuel consumption. The fee structure for transportation energy, including alternative fuels and vehicles, should have a common base and determined outside policies sensitive to alternative fuels. The marketing strategies and promotion of these types of fuels or vehicles should be formulated at different levels other than the basic tax structure.

As reflected in preceding tables, not only the amount of penetration of alternative fuels, but the mix of different alternative fuels, will be crucial factors in future surface transportation finance. Marketing the alternative fuel would effect the amount of revenue available for transportation, depending on the extent of exemptions granted to these fuels. The extent of the exemption is likely to vary among the alternative fuels, and these differences will have an effect on the relative consumption of alternative fuels, as well as on potential revenue losses.

There are fundamentally two options available to policy makers to deal with the uncertainties of alternative fuel markets on the transportation sector. One option is to bring the alternative fuel taxes into par with that of gasoline and diesel prices or mitigate revenue losses through other means. Compensating the revenue loss would stabilize the effect of alternative fuel on transportation revenues, but the complexity of fuel taxing procedures and collection will remain. It is likely that changing tax rates could effect the competitiveness and marketing of the alternative fuels. Other policy options and incentives may need to be designed, in order, to avoid undermining the long term policy objective concerning conservation and energy diversification.

The supply of the alternative fuels is not expected to be a major constraint to the near-term growth of AFVs. The availability of an adequate network of refueling sites to allow unrestricted AFV travel in the state is likely to remain constant. Special provisions, however, are necessary to obtain electricity priced for EV charging at rates considerably lower than standard electric rates. The rate payer issue has been addressed by the Public Utility

Commission in its recent proceeding. While some utilities are installing a limited number of public EV charging facilities, most charging is expected to be accomplished during “off-peak” hours at the vehicle base location. This typically requires installing proper wiring circuitry, separate meter and a charger, if the latter is not part of the vehicle equipment.

The long term structural approach to resolving the question of transportation energy taxation is to gradually move away from dependency of transportation investments on fuel taxes. This means the restructuring of the existing surface transportation finance to increasingly rely on other methods of generating revenues. The feasibility of VMT pricing in transforming the existing system is an option and further evaluated in the remaining of this report. A certain level of taxation on conventional fuel should, however, be maintained as long as it is part of the transportation energy sources.

### **Vehicle Fuel Efficiency**

A vehicle fuel efficiency scenario is likely to be motivated by similar concerns surrounding the alternative fuels (see above). It would effect fuel tax receipts and transportation revenues, more or less, in a same manner. The intensity for significantly higher CAFE standards, however, appears to have leveled off with continued moderate improvements in fuel efficiency objectives. There are tradeoffs between the improved fuel economy scenario and the alternative fuels scenario. The greater the penetration of alternative fuels into the transportation market, the lesser the pressure for higher vehicle fuel efficiency, particularly for conventional fuel. Likewise, the continuing advancement in vehicle emission control technology and fuel economy could effect the marketing of alternative fuels and vehicles.

However, this trade-off is complicated by the fact that the new generations of alternative vehicles, particularly electric, are highly energy efficient. This characteristic would enhance the effect of alternative fuels on tax receipts, in terms of gasoline displacement, as the result of increased levels of fuel economy. On an energy equivalent basis, the electric car is three to five times more efficient than a conventional car (100 miles per 35 kw/hr vs. 20 miles per/gallon, one gallon = 35 kw). The dual effect of alternative fuels, higher mpg and fuel market share, could have significant policy implications. These potential impacts might counter balance the effect of fuel tax increases or congestion management initiatives. Notwithstanding the significance of other national and state policies such as air quality, the higher mpg of alternative vehicles, particularly electric, can reduce the amount of fuel tax receipts available to transportation even further.

Similarly, a literature review suggests a wide range of possible future fuel economy for new conventional automobiles. The average estimate ranges from 10 percent to 35 percent by 2015. Table 8 summarizes the range of “technically achievable” fuel economy from various reports (8), reflecting much higher mpg than those selected for this study.

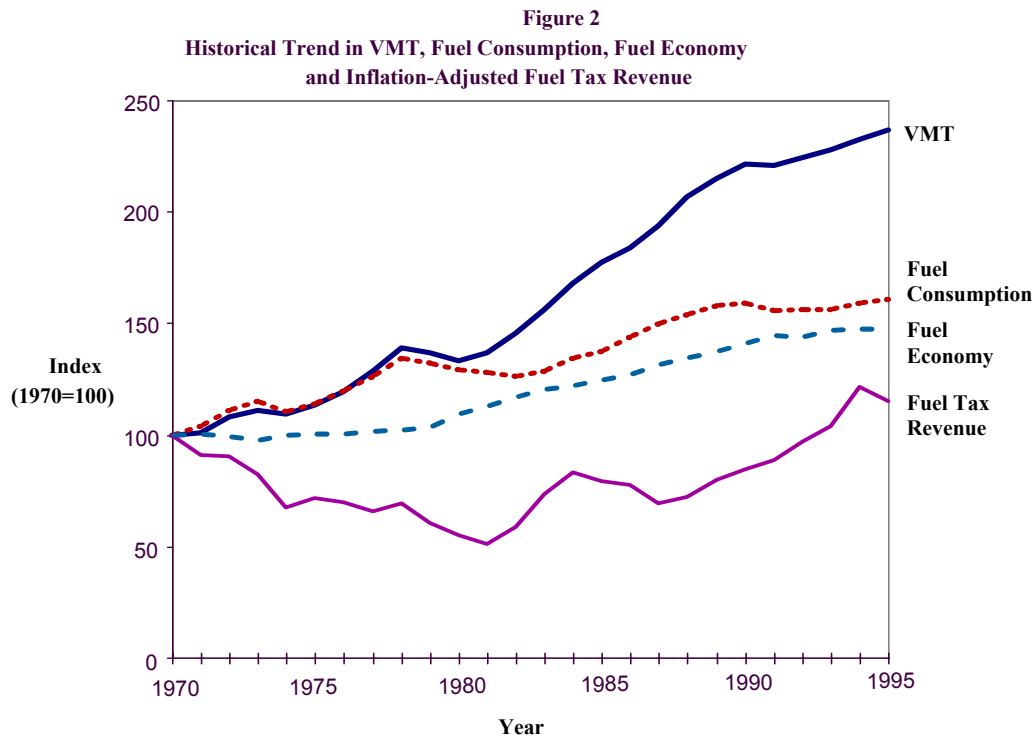
**Table 8**  
**Ranges of Technically Achievable Fuel Economy**  
**for Model Year 2006 Gasoline Passenger Car**

<u>Vehicle Size Class</u>	<u>Higher Confidence</u>	<u>Lower Confidence</u>
Subcompact	39	44
Compact	34	38
Midsize	32	35
Large	30	33
Average	33.75	37.5

Source: National Research Council

The average fleet fuel efficiency of gasoline light duty vehicle has increased from estimated 12.5 miles per gallon of gasoline in 1970 to about 21 miles per gallon by 1996. This translates to 68% improvement in vehicle efficiency and an enhanced driving capability for the same gallon of gasoline. While the fuel tax rate per gallon in absolute term has increased notably over the same period of time, the actual revenue in real dollar has remained constant when factoring inflation ( see figure 1).

Considering both inflation and vehicle fuel efficiency, the effect has been a net loss of revenue opportunity to surface transportation. At the same time, the total vehicle miles of travel in California increased by approximately 140%, more than doubled. The upward trend in VMT is likely to continue, in variable degrees and with a decreasing rate. Under the VMT pricing system the widening gap between fuel consumption and the use of facility in miles of travel would be bridged. Figure 2 shows historical trend in major variables impacting transportation revenues.



Once the impact of conventional vehicles' fuel economy and the efficiency of the alternative vehicles, particularly electric are combined, the revenue implications could even be more significant. For the purpose of this study a moderate composite average efficiency target of 22.5 mpg and 27.5 mpg are selected for 2005 and 2015 respectively. These figures are below the technically achievable fuel economy projected by some other studies (see table 8 above). This is based on a conservative review of CAFE standards and a technically achievable fleet fuel economy as well as reasonably priced fuel efficient passenger cars for US market.

Assuming 20 mpg average fleet fuel economy as the base case, the fuel economy of conventional vehicles would improve 12.5 percent by 2005 and 37.5 percent by 2015. This would mean 12.5 and 37.5 percent more VMT per gallon of gasoline free of charge to the driver. Table 9 reflects projected potential revenue loss to future transportation due to improved fuel economy of conventional vehicles. Values in these tables reflect the magnitude of fuel economy impact and potential loss of tax receipts. The figures indicate that the historical revenue loss will continue, although at a slower rate.

**Table 9**  
**Projected Potential Revenue loss to Surface Transportation**  
**Due to Light Duty Vehicle Fuel Economy**

	Improved Fuel Economy	Total VMT (in bil.)	Gained VMT (due to fuel economy)	Gasoline Displacement (in bil.)	Potential Revenue Loss
Conventional Vehicles	2005 = 12.5%	241.616	30.202	1.34	\$0.49
	2015 = 37.5%	294.303	110.36	4.01	\$1.46

\* assumes gas taxes remain constant. Total VMT does not include VMT from EVs.

Similarly, table 10 summarizes projected gasoline displacement for high fuel economy (mpg) electric vehicle penetration scenario. The impact of high performance conventional and alternative fuels vehicles when taken together is potentially large, resulting in estimated \$650 million less in fuel tax receipts by 2005.

**Table 10**  
**Revenue loss to Surface Transportation**  
**due to Penetration and Fuel Economy of Electric Vehicles**

	<u>2005</u>	<u>2015</u>
Gasoline Displacement due to EV Market Penetration (in billions of gallons)	312	644
Additional Gasoline displacement due to EV fuel economy (50% more Efficient -in millions of gallons)	<u>156</u>	<u>322</u>
Total gasoline displacement	468	966
Potential Revenue Loss (in billions of dollars)	\$0.17	\$0.35

\* assumes gas tax remain constant.

The California Public Utility Commission in its recent proceedings underlined procedures for the electricity rate for transportation use and rate payers provisions. The taxation on alternative fuels is a separate process and determined through legislative process and conditioned by state and federal programs. The level of taxation that would be necessary to compensate for the alternative fuels' share of the transportation fuel market and to make up for the improved fleet fuel economy should be assessed.

### **Combined VMT Fee and Fuel Tax Structure - Full Freeway System**

As stated earlier, the realization of a combined VMT fee system and fuel tax structure scenario is dependent on the availability of a viable region-wide application of automated vehicle identification for measuring VMT, at least for the freeway system. The basic technology to implement VMT fee concept does exist, although not well refined. This can be done in a variety of ways, such as open versus closed tolling as described previously. However, the scale and magnitude of the program present certain obstacles which need to be resolved before road pricing can be established on a full freeway system. The cost of implementation and operation of the system could be high depending on the type and planning of the system. For the purpose of this analysis, it is assumed that technological, institutional, interjurisdictional

problems can be worked out if the scope of the pricing program is narrowly defined. It appears, for example, that the more advanced open ETC system, such as GSM/GPS systems would not be feasible in near term, while basic closed ETC system is technically marketable.

The primary rationale for establishing VMT pricing on the limited access state freeway system is an attempt to focus road use charges on a manageable level and as an incremental step in a transitional path to a self sustaining, dedicated financing system. Further, freeways carry a predominant portion of total vehicle miles of travel (about 74%) and widely recognized as the primary focal point of congestion in urban areas. Conceptually, a relatively simple “closed” electronic toll system could be used for the entire state freeway system or a regionally defined freeway segments with all ramps equipped with ETC. The typical closed ETC system appears a suitable technology for VMT pricing on a limited access freeway system which is equipped with readers and vehicle classification and enforcement devices. The mainline highway segments would not need to be equipped under this system, reducing additional installation cost.

The financial viability of the VMT pricing system would be linked to the likely growth or level of VMT on the freeway system. The assumption is that the revenue generated from current fuel taxes (with no future tax increases) plus the revenue generated from VMT fee on freeway system would be more stable and sufficient to pay for future transportation investment needs. The combined VMT /fuel tax scenario appears as the most realistic and more productive alternative in fundamentally reforming the existing system toward a new transportation financing structure.

It is recognized that the level of VMT, therefore, the revenue level may be effected by the state and national policies concerning energy efficiency, vehicle emissions, and budgetary practices as well as increased investment in transportation infrastructure. The first three types of policies may result in reduced growth rate in personal use VMT ( e.g., via high taxes on fuels, emission fees). The policy on transportation investment could potentially increase highway use and increased highway revenues. This is, however, unlikely as long as the highway user taxes are diverted to other public policy uses. The proposed NEXTEA, for example, retains the same level of funding for transportation investments, including 4.3 cent for federal deficit reduction.

It must be noted again that , in evaluating revenue implications, the variations in future VMT is considered less important than the trend which is projected to be upward. The objective is not accounting accuracy, but the range and magnitude of the VMT impact. Tables 11 and 12 quantify the likely level of VMT impact on transportation receipts. Both flat and variable

fees are considered. The variable rate reflects surcharges on congested highway miles while flat fee is constant and universal. The VMT projections assume continuing growth in highway uses but at a declining rate. This is consistent with assumption of continuing moderate economic growth as well as some leveling off in the rate of VMT growth due to increasing congestion and cost of travel. The projected revenues do not consider the potential impact of VMT fee on travel demand. A recent study on congestion pricing seems to suggest that on average a 10-cent per mile could result in roughly .2% reduction in overall VMT (9).

The flat VMT fee application is rather simple and does not differentiate between prevailing factors (i.e. facility type, the-level-of-service, vehicle type). The above table suggests that the revenue generated from light duty vehicles on the state freeway system could be significant even with nominal fees. The inclusion of heavy duty vehicles would increase the revenues proportionately and considerably.

<b>Table 11</b> <b>Flat VMT Fee/light duty vehicle</b> <b>Projected Revenues from State Freeway System</b>						
VMT Fee	VMT 1996 (billions)	Current Estimate	VMT 2005 (bil)	Projected Revenue (2005-bil.)	VMT 2015 (bil)	Projected Revenue (2015-bil.)
	76.515		96.346		118.168	
2 cents-Flat		\$1.530		\$1.926		\$2.363
5 cents-Flat		\$3.825		\$4.813		\$5.908
10 cents-Flat		\$7.650		\$9.630		\$11.810
* assumptions: the freeway system generates roughly 74% of the total VMT on the state freeway system. private auto reflect roughly 70% of the total vehicles using the freeway system. does not include the impact of VMT fee on travel in terms of diminished demand.						

The variable rate scenario is more complicated but more equitable, because it could respond to different policy and operational objectives, (i.e. facility and vehicle type, congestion, income groups). For the purpose of this analysis and in light of the need assessment, a modest range of fees are considered. The

scheduled rates reflect a 5 cent base fee for both rural and urban portion of the highway system, a 3 cent surcharge on congested rural segment, and a 5 and 7 cent surcharge on congested urban miles of travel. The intent is to differentiate between levels of demand and capacity available, including a more equitable user fee for urban and rural roadways. Note that the differential fee system could also incorporate vehicle classes and characteristics through additional surcharges. The following table does not include those aspects.

The following table is constructed to demonstrate how an scheduled VMT pricing would work and the level of revenue it would potentially generate. Additional surcharges can be added based on vehicle pollution rates and characteristics for air quality objectives within non attainment areas. The variable fee system is multi-purpose, more equitable, and generates significant amount of revenue with nominal tolls. The system is flexible and could be designed in a way that can be responsive to a range of strategic objectives and priorities (i.e. revenue source, congestion management, air quality).

<b>Table 12</b> <b>VMT Variable Fee/light duty vehicle</b> <b>Projected VMT fee Receipts from</b> <b>State Freeway System</b>				
	VMT (private auto) in billion)	3 cent	VMT FEE	
			5 cent	7 cent
Congested/Rural	7.824	\$0.234		
Congested/Urban	34.773		\$1.738	\$2.434
Total VMT/1996	86.934		\$4.346	
Total Revenue/current			<b>\$6.318</b>	<b>\$7.014</b>
Total VMT/2005	96.346		\$4.82	
Congested Rural/2005	10.262	\$0.3078		
Congested urban/2005	70.770		\$3.538	\$4.953
Total Revenue/2005			<b>\$8.66</b>	<b>\$10.08</b>
Total VMT/2015	118.168		\$5.908	
Congested Rural/2015	37.855	\$1.135		
Congested urban/2015	73.011		\$3.650	\$5.110
Total Revenue/2015			<b>\$10.693</b>	<b>\$12.153</b>
* assumes total lane miles will remain constant through 2015. does not include the impact of VMT fee on travel in terms of diminished demand.				

If the VMT pricing system were to compliment the current fuel-based tax, future revenue streams would be more stable and in line with transportation needs assessment. Table 13 shows the estimated revenues under the combined VMT/fuel tax system as compared to the current fuel tax program.

The table suggests that the combined fuel tax and a variable VMT fee would likely generate the optimum level of revenue. One important factor to consider is that the broader the application of VMT pricing, the less significant geographic and other equity concerns may become. The share of VMT by income group is reported to vary by income level. The higher the income the higher the personal VMT ( 8.8% for lowest income quintile and 32% for the highest income quintile)(10). This seems to suggest that VMT fees are sensitive to per capita income, providing a degree of equity for different income brackets. Further, the broader the application, the lower the per-mile rate would need to be to achieve the revenue target or other objectives, such as air quality and demand management. The public opinion polls on transportation pricing appears mix. Certain polls seem to indicate that more people believe that “fees on roads” represent a fair method of funding transportation and air quality programs.

<p style="text-align: center;"><b>Table 13</b>  <b>Projected Revenue</b>  <b>Combined Fuel based System and VMT Fee /Freeway System</b>  <b>(in billions)</b></p>			
	1996-97	2005	2015
A. Fuel Based Tax	\$2.880	\$3.280	\$3.625
B. VMT Flat Fee/ (5-cent)	\$3.825	\$4.813	\$5.908
C. VMT Variable Fee (3-5-5-cent)	<u>\$6.318</u>	<u>\$8.662</u>	<u>\$10.077</u>
Total A and B	\$6.705	\$8.093	\$9.533
Total A and C	\$9.198	\$11.959	\$13.702

The cost of implementing the VMT pricing system on the full freeway is difficult to estimate, given the lack of cases where similar system is now in use. Table 14 attempts to summarize the magnitude of capital and operating costs associated with a statewide system. The major components of cost are

primarily associated with installing electronic devices on each of an estimated 27 million vehicles in California by 2005, properly equipping the state's 9,427 gas stations, and installing antenna reader devices on approximately 13,383 freeway system's "on" and "off" ramps. Significant contingencies of 30 percent and 10 percent is added to capital and operational cost estimates to account for uncertainties of the new application. Values in the following table reflect a fairly high cost of implementation and is a broad estimation of likely cost categories.

The capital costs would be a one-time cost which can be amortized annually. The administrative and operating cost of this system is by far higher than the present fuel tax system, but would be expected to decline in long term. The estimated cost of administering the fuel tax program in the state is about \$85 million (based on 3%) vs. \$0.502 billion for the new system. It is important to note that the pricing system has the potential to generate significant amounts of revenue as well. The benefit associated with the VMT pricing is also expected to be high. Further, the initial phase of the system would be confined to a defined regional system and is likely to cost much less.

<p><b>Table 14</b>  <b>Magnitude of System Costs (unescalated)</b>  <b>VMT Fee on Full Freeway System</b>  <b>(in billions)</b></p>	
<b>Cost Component</b>	
Capital Costs	
On-Board Devices (\$120 per vehicle)	\$3.24
Gas Station Equipment (\$15 k per gas station)	\$0.141
Antenna Reader Devices (\$1000, including installation)	\$0.133
Other costs and Contingency (30%)	\$1.054
Total Capital Cost	<b>\$4.569</b>
Annual Amortization	\$0.41
Operating Costs	
Annual Operating Cost (at 10%)	\$0.4569
Contingency -enforcement and Compliance (10%)	<u>\$0.0456</u>
Total Operating Cost	\$0.5025
Total Annual Cost	\$0.907
<p>that vehicles need to be retrofitted with new devices, rather than being equipped at the time of manufacturing. assumes amortization at 6%</p>	

## Full VMT System

The transformation from the fuel-based financing system into the full VMT measurement financing structure differs greatly from the combined fuel tax and VMT fee system and other scenarios in important ways. The technological requirements, achievements in technological development, and the technology options are critical factors in the feasibility of the full VMT system. The technological development process is influenced, to a significant degree by public policies and market incentives. The desirable technology is linked to transportation financing reform policies and processes. The transitional mode (i.e., the implementation of the combined VMT-fuel tax scenario), is a significant step in realizing a workable financing system based on full VMT measurement.

The full VMT system incorporates both the state highway system as well as local streets and arterial routes. Such a system ideally requires an open system of revenue collection (i.e. GSM/GPS systems), given the non-access control nature of the local streets and no individual ramps to monitor vehicles. Once the VMT fee is extended to non-limited access facilities, the technological complexity and capital costs would increase exponentially. The additional revenue beyond that which can be collected on the highway system alone may not be significant relative to capital cost required for implementing the system. Table 15 reflects potential revenue implication of the full VMT measurement.

The timing and rate of technology introduction suitable for full VMT measurement is probably dependent on the availability of cost effective and practical technologies. Some are available now, but more sophisticated technologies are in the development process. It is difficult to assess the rate of market introduction, but it is likely to be limited during the first projection period (2005). Its probability is likely to increase for the latter part of the transition period (2015).

If a VMT based tax replaces the current fuel tax, future revenue would be higher when compared to the fuel tax system. Under the VMT fee program, revenue increases in proportion to growth in vehicle miles of travel which is estimated to be higher than the rate of gasoline consumption and more in line with inflation rates.

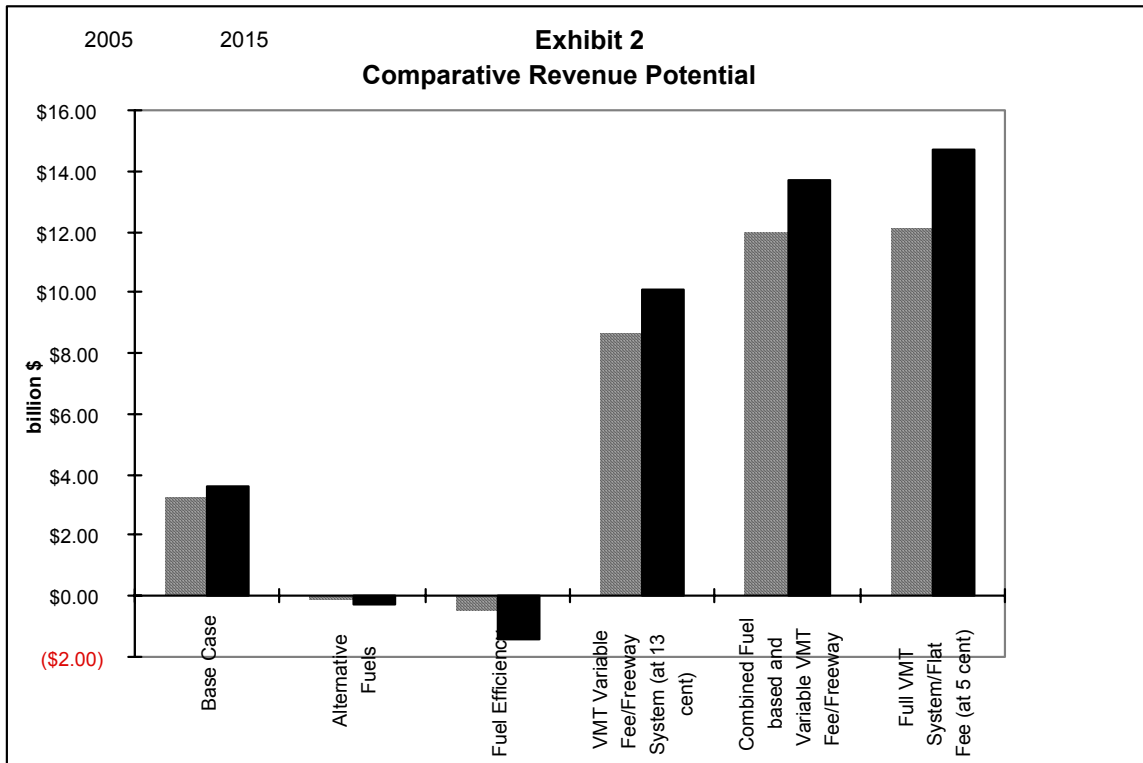
The full VMT pricing program, while attractive, is technologically problematic and cost-effectively prohibitive at this time. The future technological advances in global positioning systems, multi-use transponders, and other intelligent features may well become feasible and would significantly enhance the attractiveness and feasibility of full VMT pricing

system. Once these technologies find their way to the market place, the cost of implementing and operating a VMT fee program would be greatly reduced, therefore, eliminating cost as a major barrier to implementation.

<b>Table 15</b> <b>Full VMT System/Flat Fee</b> <b>Projected Revenue from State Roadway System</b> <b>(highways and local streets)</b>				
	Total VMT	2-cent	3-cent	5-cent
1996	198.406	\$3.968	\$5.952	\$9.920
2005	241.616	\$4.832	\$7.248	\$12.080
2015	294.303	\$5.886	\$8.829	\$14.715

### Comparative Revenue Implications of Alternative Scenarios

The preceding sections provided basic information on the current financing system (base case scenario) and for alternative revenue sources. Exhibit 1 (next page) demonstrates the comparative impacts of alternative scenarios in terms of potential levels of revenue for future surface transportation. Note that alternative fuels and fuel efficiency bars indicate the amount of revenue loss. The base case scenario maintains steady growth in highway revenues relative to fuel consumption. Projections concerning other alternative scenarios assume continuing moderate economic growth and increasing VMT growth, but at a declining rate.



## CHAPTER V

### Framework for Evaluating Revenue Sources

In the previous section, potential future scenarios were analyzed. In what follows the feasibility of selected alternatives are further evaluated. The scenario analysis and evaluation framework were designed to support the public policy decision process. The impetus of public policy evaluation is attributed to the fact that: a) the policy alternatives are defined in a way that their impacts can be identified, b) those impacts can be measured (approximated) or described based on a set of criteria, and c) policy makers and analysts can effectively rank preferred alternatives and describe the most appropriate courses of action.

The proposed evaluation framework is limited in scope, but provides a guide for the systematic approach to evaluating the VMT and other selected alternative revenue sources. It is basic but responsive to key financing issues and the dynamics of the policy making process. Given the focus of this paper, the most important criteria is the revenue generating potential of alternative methods. Other criteria are also used to determine the adequacy of alternative methods.

In the earlier section concerning alternative pricing options, a brief description of the VMT fee pricing method and broad definition of VMT variations, including pricing strategies, was presented. In light of these pricing options and the alternative scenarios discussed above, the following revenue sources were selected for evaluation:

- Full VMT fee
- Combined VMT and Gas Tax
  - flat VMT fee
  - variable VMT fee, including congestion fee
- VMT/Emissions Differential Pricing
- Maintaining fuel tax system
  - programming reform
  - increase gas tax

The following table outlines a set of evaluation criteria to be used for the practical assessment of VMT pricing as a complement or replacement for dedicated fuel taxes. The framework provides basic guidelines on whether

the VMT fee constitutes a reliable and consistent source of revenue and worth considering as a realistic component of future transportation financing.

<p style="text-align: center;"><b>Table 16</b> List of Evaluation Criteria</p>	
<u>General Category of Criterion</u>	<u>Requirement</u> <u>s</u>
Technology requirements	<ul style="list-style-type: none"> <li>• must be simple and available with reasonable cost.</li> <li>• minimal physical necessary to implement pricing program.</li> <li>• capable of facilitating enforcement and minimizing evasion.</li> </ul>
Revenue generating potential	<ul style="list-style-type: none"> <li>• generate significant net revenue, or substitute for other revenue sources.</li> </ul>
Consistency and predictability of revenue source	<ul style="list-style-type: none"> <li>• revenue streams must be easily projected with good degree of confidence.</li> <li>• assure continuity and long term stability.</li> </ul>
Flexibility and responsiveness to public policy or market changes	<ul style="list-style-type: none"> <li>• increase drivers awareness of cost of driving.</li> <li>• consistent with regional and state planning goals and policies - i.e. mobility, air quality, energy efficiency, demand management.</li> </ul>
Effectiveness and economic efficiency of the revenue source	<ul style="list-style-type: none"> <li>• defined and measurable units of taxation or fee</li> <li>• direct relationship of revenue generated with use of the facility or vehicle.</li> <li>• meet marginal cost of driving.</li> </ul>
Transportation Impact	<ul style="list-style-type: none"> <li>• improve operational efficiency of roadways- i.e. reduce peak period travel.</li> <li>• encourage alternative modes of travel.</li> <li>• minimal impact on intra-regional arterial and roadway network.</li> </ul>
Equity and fairness - distribution of benefits and costs by special class	<ul style="list-style-type: none"> <li>• negative economic impact can be mitigated.</li> <li>• sensitive to demographic variables i.e. income groups.</li> <li>• differentiate between classes of facility, vehicles characteristics, and level-of-service.</li> </ul>
Feasibility of implementation	<ul style="list-style-type: none"> <li>• be implementable and enforceable regionally as well as statewide.</li> <li>• capable of being staged -built incrementally from a locally defined system to a fully operational statewide system.</li> <li>• reasonable capital and administrative cost.</li> <li>• politically feasible - can gain public and legislative support.</li> </ul>

It needs to be reiterated that this study focuses on revenue generating mechanisms as a complement to the existing system and the State's functional responsibility in maintaining an advance transportation system. Tactical financing methods were not discussed. If a pricing method was not considered or do not satisfy the above criteria, it should not necessarily mean that these methods are inadequate. Those revenue sources may be utilized

as part of the transportation financing by the state and localities, even though they cannot replace the existing fuel-based financing system.

## **Evaluation of Selected Alternatives**

The evaluation of the revenue sources was achieved using several basic criteria and information provided as part of the earlier scenario discussion.

### **Full VMT Pricing**

**Revenue Potential:** The total light duty vehicle VMT (private auto) on the state highway system and local streets and reached an estimated 198.4 billions in 1996. This represents over 70% of the total VMT in California. A 5-cent flat fee on auto VMT would generate about \$9.9 billion annually. This would satisfy the proportionate share of private vehicles for the cost of maintaining the state transportation system, given the future needs assessment (see table 1). This figure corresponds to an equivalent of a \$1.09 gas tax, an increase of about 72 cents in current gas taxes. Heavy duty vehicles would also generate significant revenue based on a flat fee schedule. It should be noted that the implications of VMT on the truck category will be evaluated in a separate report. Historically, an increase in gas tax revenue amounts to an average of 1% annually, below the rate needed for identified transportation investment needs. Considering the total transportation system needs, relying on fuel taxes as a primary source of revenue is becoming increasingly more deficient.

The issue of in-state and out-of-state vehicle registration complicates the tax rate as well as administration of the VMT pricing system. The total number of vehicles registered in California is stated at 15.660 million for 1996. This figure reflects 94% of the total VMT generated on state roadway system. Consequently, the fee must be adjusted upward to compensate for out-of-state registered vehicles and travelers. Having in-state auto owners pay for out-of-state drivers is inappropriate. Such a dual tax system creates major equity and marginal cost issues which ought to be resolved before the VMT pricing system can be implemented. There are a number of proposals to minimize that problem, such as providing curtesy transponders and guest booths at the state boarder.

**Consistency and Predictability:** VMT indicators, such as population and vehicle registration are projected to increase. While there are variations, it is forecasted that VMT will continue to grow, but at decreasing rate. A VMT fee would be relatively stable and predictable. VMT forecasts used in this report would represent likely growth in VMT under current policy conditions. In the 2000s, this reflects about 25% growth as population and personal income slows down. Transportation revenues will grow proportionately to

VMT growth (see tables 11 and 12). This is directly correlated to auto travel and use of roadway facilities. The linkage between gas tax and the use of transportation facilities is expected to weaken further. The increasing vehicle fleet fuel economy and the penetration of alternative fuels could result in revenue loss of \$.658 billion by 2005 (see table 9, 10) While the revenue from gas tax is expected to increase in proportionate to gasoline consumption (\$3.290 billion by 2005), its rate of increase is considerably lower than VMT, assuming no major increases in the gas tax.

A low VMT growth rate in which the personal-use VMT could appreciably decrease is also possible. State and national policies might result in a reduced rate of growth in personal VMT, such as reducing energy consumption through taxes on fuel or carbon content of fuel; reducing vehicle emissions via emission fees; or travel reduction through transportation control measures. NEXTEA proposes, for example, a 25% increase in CMAQ funding. The cost and effectiveness of this enhancement program as well as its impact requires closer attention.

**Effectiveness and Economic Efficiency:** A flat VMT fee would not differentiate between classes of roads or vehicles and rarely covers the marginal cost of travel, unless it is set high. It is, however, easier to enforce and has a lower administrative cost when compared to a variable VMT fee. Equity becomes an issue, since a flat fee could have a disproportionate impact on travelers. However, given the large pool of contributors, a relatively low VMT fee could still generate a significant amount of revenue. At the lower fee the cost to the driver is comparative to the gas tax system, but provides a better shield against inflation in long term. Assuming a fleet performance average of 20 miles per gallon, the average state and federal gas tax paid by the driver is currently about 1.82 cents per mile. Inflation would erode the value of this tax, since fuel tax is not indexed. The revenue generated from a constant 36.4 cent gas tax would average to \$3.8 billion in 2005, while a flat VMT fee of 1.82 cents would generate about \$4.4 billion. In this case, the level of revenue is higher and more in line with the inflation rate. Under the low VMT growth rate scenario, revenues will also decline, but not at the level of gas tax yields.

The economic impact of the VMT fee system, in terms of business interest and competitiveness, is not well known and depends on the level of scheduled fee. However, if a variable VMT fee is substituted for fuel tax it would likely influence travel decisions more so than fuel tax. In the case of VMT fee examples in this paper, the magnitude of impact would be low given the comparative fee levels with the fuel tax.

**Technology Requirements:** The full VMT pricing system incorporates both the state highway system and local streets and roads. Once the pricing is

extended to non-limited access facilities, the technological complexity increases significantly. Not only would this necessitate an exponential increase in the capital cost of an electronic toll system, a viable, cost-effective technology to implement a full VMT system is not and unlikely to be available for commercial use within the next 15 years. Such a massive operation would also complicate enforcement efforts and administrative procedures. Consequently, the full VMT pricing system is technologically and cost prohibitive. This scenario will not be considered as an alternative to the fuel tax system.

### **Combined VMT Fee and Fuel Tax Structure - Full Freeway System (Flat and Variable Fee)**

**Revenue Potential:** The total VMT on the state highway system is estimated at 147.713 billion in 1996. The freeway system, the access controlled segment of the state highway system, generates about 74% of the total VMT or 109.307 billion VMT. The freeway system consists of urban and rural facilities. On the basis of a V/C ratio of 0.8, it is projected that on average 80% of urban VMT and 40% of rural VMT on the freeway system will be considered congested by the year 2005. It is evident that by any criteria, congestion on the state highway system is progressively increasing.

Transportation revenues from fuel tax receipts is estimated at \$2.88 billion for fiscal year 1996-97. Given revenues from other sources, the total unfunded need for the transportation system based on table 1 is about \$8.59 billion per year. The state highway shortfall is about \$3.66 billion. In the combined VMT fee and fuel tax financing system, the revenue short fall or under pricing of transportation services can be made up through modest VMT fees.

Table 8 projects the magnitude of a flat fee revenue. For example, 10 cents fee per mile would likely generate additional revenue needs (about \$7.65 billion for 96-97). A variable rate would generate about the same amount but tends to be more equitable. A variable VMT rate is flexible and can be designed to be responsive to, for example, time-of-travel and type of facility. This method would better meet the need for mobility as well as other strategic objectives such as congestion and air quality, beyond its revenue potential. As reflected in table 12, a surcharge of 3 cent and 5 cents over the base line VMT fee could differentiate between the type of facility (urban vs. rural) and the level-of-service (congestion).

**Consistency and Predictability:** The combined fuel and VMT based financing system has the advantage of balancing gas tax and VMT fees to achieve an optimum impact both on transportation revenues and travel demand management. Such system could generate about \$9 billion based on freeway

user fees. As the VMT pricing structure evolves from a facility specific to a complete freeway system, the pricing mechanism can gradually move away from fuel-based taxes to a user fee based system. This provides consistency in reforming the financing system and stability in predicting future revenues. Consequently, the transition costs associated with changing methods of taxation and windfall gains and losses are minimized. Given the incremental approach to restructuring the financing system, the cost of change can be more accurately, though imperfectly, analyzed and evaluated.

Both VMT and fuel consumption is projected to continue to grow, barring any unforeseen oil crisis or extreme travel demand management measures. The potential impact of current programs and policies on surface transportation revenues is discussed previously. The impact of electric vehicles alone is projected at \$170.00 million annually in terms of revenue loss by 2005. Considering other programmatic initiatives and technological advances, the overall impact could be much higher. For example, including the potential impact of conventional vehicles' improved fuel economy, the revenue loss could reach \$650.00 million by 2005 ( see alternative fuel scenario). What is also of concern beyond revenue loss, is the instability with the process of current revenue projections. This creates programming imbalances due to changing variables and confluence of many programs and policies. Introduction of VMT would minimize fluctuations in the revenue projection process.

**Effectiveness and Economic Efficiency:** Given the fuel tax system's historical weakness in coping with inflation and the cost of providing transportation services, VMT fees would compensate for the lack of inflationary indexing. While the cost of highway and other modal construction and maintenance has stayed roughly similar to general inflation over the long period of time, it has followed different patterns and is less predictable trend. At the same time, the value of transportation revenues in real dollars has stayed flat or slightly declined since 1955, because the tax rate has not been adjusted to obtain a targeted real yield (see figure 1). This would suggest that, in relative terms, while the size, complexity and the needs of transportation system have changed significantly over the years, transportation expenditures have remained relatively at the level of the early interstate highway era. The

erosion in real value of tax receipts is coupled with the fact that automobile owners pay increasingly less relative to their use of transportation facilities. While fuel taxes reflect more closely with the cost of driving early on, revenue collections have been decreasing in real value, because of a weakening correlation of gas tax, driving behavior, and use of the transportation system.

Both the gas tax and flat VMT fees could have disproportionate effect on the private use of the auto, particularly, in terms of facility use and vehicle fuel

efficiency. The element of differential VMT fees would, however, bring a degree of equity into the existing financing equation by differentiating urban and rural facilities, classes of vehicles, and the level of congestion, among others.

**Technology Requirement and cost:** The scope of the VMT pricing system in this scenario is narrowly defined and confined to the access controlled freeway system. Further, it is assumed that the system is built incrementally from a defined regional segment freeway system (core single facility) to gradually include a larger statewide system. Considering this staged approach, the basic technology to implement VMT pricing along with the fuel based system does exist as discussed earlier. What is needed is a carefully designed functional plan for the ETC system with effective implementation and enforcement techniques and programs. The initial cost of a statewide system would be high but its revenue generating potential would also be significant. The one time implementation cost could be as much as \$4.65 billion plus annual operating cost (see table 14). The total annual cost could go as high as an estimated \$0.907 billion. The initial leg of the system, however, which would be confined to a regionally defined segment of a freeway system, should cost significantly less.

It is expected that in a technologically oriented pricing system with many tax payers, potential for evasion and compliance cost would increase substantially, particularly in the early stages. The compliance cost per tax payer for the VMT system could amount to about \$20.00 annually and a 10% potential for tax evasion according to some estimates. Such costs for current fuel taxes are very low, although diesel and gasohol evasion rates are rather high. It is, therefore, critically important that development of a VMT pricing system architecture include strong prevention and tamper-proof components to ensure a reasonable cost of operations and compliance.

### **VMT/Emissions Differential Pricing**

**Revenue Potential:** The primary strategic objective of this alternative is to provide incentives to use low emission vehicles. The higher the emission rates the greater the emission fee. While emission fees could generate significant amount of revenue, the primary concern is air quality and discouraging those contributing the maximum to air pollution. The level of revenue directly correlates with the rate of pollution produced by a vehicle. The statewide average exhaust ROG emissions for light duty vehicle fleets in California was estimated at .58 grams/mile for 1996. The Nox and CO emission rates are .71 gram/mile and 4.56 gram/mile respectively. These figures do not include trip-end emissions. The emission rate of 2 cents per gram per mile on ROG, for example, could generate \$1.2 billion based on state highway miles. Additional charges can be assessed for Nox and CO.

**Consistency and Predictability:** The emission fee is mainly assessed based on classes and characteristics of vehicles, rather than the use of the transportation facility. This could lead to the problem of disconnecting the emission fee from the transportation system user. This is similar to the gas tax problem. The result is that as vehicles using the system become cleaner and less polluting, the revenue collections decreases. Vehicle emissions have been declining and are projected to continue to decline, although this trend cannot continue indefinitely. The rate of reduction in emissions per mile would offset the annual growth in VMT. The decline in the vehicle pollution rate averaged about 2.5 percent per year since 1990, while the VMT annual growth rate was estimated under 2 percent over the same period. In that case, emission fee revenues would have declined by at least an average of 0.08 percent per year since 1990 (1990 ROG fleet emission rate was .73). Consequently, emission fees would need to be adjusted annually relative to VMT growth rate to ensure a steady revenue stream. This is politically and legislatively problematic.

Enforcing emission fees is expected to accelerate the rate of the alternative fuels market penetration and vehicle fuel economy. This effect could further erode potential revenues, if alternative fuels and vehicle economy continue to maintain preferred tax status. The potential revenue loss to surface transportation from the market share of electric vehicles alone is projected at \$170.00 million by 2005, not considering the surcharge impact of the emission fee program. In order to minimize instability in emission pricing, the fee should be assessed on the top of the base line VMT fee or as part of congestion pricing. The emission fee program by itself is not a stable source of revenue and cannot be used as a substitute for the fuel tax or an integrated component of the financing structure.

**Effectiveness and Economic Efficiency:** Inflation compounds the above problem. However, the gap between the VMT growth rate and the fleet average emissions rate is expected to narrow and, in the long term, stabilize, given the limits in vehicle emission technology improvements. This would effectively move emission pricing closer to VMT pricing. Transportation revenues become, generally, the product of VMT and VMT growth. The marginal utility of emission pricing is linked to the marginal change in rate of pollution. The strategic significance of that system would diminish as the emission targets are reached.

**Technology Requirements:** In concept, emission pricing is relatively simple. Vehicles would be categorized based on age and nominal emission levels. The rate per mile for VMT could vary based on vehicle characteristics and usage. In practice, technological consideration may become more challenging. If VMT fees with an emissions-differential rate structure is to be effective, a

fairly wide range of VMT fees would be needed. This would encourage the use of low emission vehicle, but requires much more sophistication in on-board equipment to minimize the potential for fraud and odometer rollbacks. It is suggested that a possible approach to technological difficulties is to assess VMT surcharges based on the gallons of fuel pumped as part of a gasoline purchase. The cost associated with the emission pricing method is also extensive with increased potential for evasion and enforcement requirements.

In light of the technological challenges and costs as well as the fact that emission pricing, in the ultimate sense, is de facto VMT pricing, this method would not be considered as an alternative to the fuel tax system. It is assumed that, if need be, the element of emission control can be added to the VMT pricing system at a later stage.

### **Maintaining fuel tax system (programming reform, increase gas tax)**

#### **A. Increase Gas Tax**

Revenue Potential: Fuel taxes account for about 85% of the revenue collected for the state's transportation system. This is the largest source of tax revenue from highway users. The total gas tax receipts amounted to \$2,880,500,000 in 1996-97 fiscal year based on 36.4 cents state and federal gas tax, excluding sales tax and miscellaneous charges. This translates to roughly a 1.8 cents user fee per mile. Twelve cents out of 18.4 cents federal gas tax is credited to the highway trust funds, 95% of which returns to California. Based on the needs assessment (table 1) and the proportionate share of the gas tax to total revenue, there is a \$3.66 billion deficit annually for the state highway system and \$ 8.59 billion in terms of total transportation system needs (unescalated numbers). The fuel tax rate, in this case, would have to increase by 40 cent and 95 cent per gallon respectively to compensate for the revenue short fall, not including the potential for diminishing impact on fuel consumption due to the tax increase. Such taxing objective would create an unrealistic policy direction and a scenario with little political support.

Consistency and Predictability: The fuel tax is simple and relatively stable. Gasoline consumption is projected to continue to grow, barring any unforeseen fuel crisis. Fuel tax receipts would grow in proportion to fuel consumption and projected to reach \$3.280 and \$3.625 billion for 2005 and 2015 respectively (assuming average %1 historical annual gas tax revenue increase). This is, however, far short of the future needs assessment. Current budgetary problems and under funding of transportation projects would continue to persist and further erode if no major reform of the existing

fuel-based financing system is undertaken. The penetration of alternative fuels and enhanced vehicle fuel economy as well as demand management and air quality initiatives, based on existing and emerging programs, would potentially reduce the rate of fuel consumption and, in effect, transportation revenues (see part B, below).

Adjustments in the fuel tax rate is primarily a product of political and legal processes, rather than transportation planning or economics. Policy and technical analysis must be effectively presented to the legislature and decision makers as well as the public. Fuel taxes have increased periodically by the state legislatures in response to increasing needs for highway and transportation revenue. This process is, however, unpredictable and cannot be systematically used to adjust fuel tax rates. In minimizing such problems, several states have adopted a variable tax rate policy. Fuel taxes are automatically adjusted at specified intervals in response to changes in fuel prices or in response to some index of prices or highway costs. California may need to consider such a policy as an interim measure in reforming the existing system.

**Effectiveness and Economic Efficiency:** One of the structural problems with the existing fuel based financing system is the lack of price indexing. It is necessary to alter the tax rate to maintain a real value of tax receipts and keep up with the increasing demand generated from the movement of people, goods and services. The inflation rate is projected at 2.7 percent which would overwhelm the 1% historical increase in fuel tax revenue. While transportation revenue is projected to increase in response to higher fuel consumption, the transportation system has to increasingly accommodate more vehicles and VMT. Consequently, increased demand on the system would escalate transportation needs and cost, further eroding the ability of the current tax structure to support transportation financing.

Historically, highway cost allocation analyses have been used to determine what the equitable share of highway costs are for various classes of highway users. The analysis has primarily been based on the principle that highway users should pay for the costs that are occasioned by their use of the highway system. The cost responsibility for light duty vehicles varies according to studies but, generally, are estimated at about .90 cents per mile. Fuel related taxes paid by the light duty vehicle is roughly 46.4 cents based on current average gasoline prices at the pump (including state sales tax). Factoring in other local sales tax and measures, private autos pay about 60% of their cost responsibilities. The factor complicating the equity formula is that automobiles with greater fuel efficiency would pay proportionately less when compared to those with much poorer fuel economy.

Technology Requirements: There is no technology requirement beyond what is already in place or a need for infrastructure development.

## **B. Programming Reform**

Revenue Potential: While adjustments in the rate of the gas tax have been a trying legislative process, the political feasibility of raising the gas tax continues to be tested periodically with, at times, significant results. The Transportation Blueprint Legislation increased transportation revenues by \$18.5 billion during the decade of the 1990s, in part, through a 100% increase in the state gas tax. The basis of this funding source has, however, been significantly eroded due to budgetary practices, under funding of needs, preemptive priorities, bond measure failures, and other factors discussed earlier. These factors have reduced the amount of the new revenues available for transportation to 63% of the original 18.5 billion, a deficit of 6.7 billion, according to the California Transportation Commission (CTC). As a result, STIP investments have been reduced to 70% of the intended level. This means an additional \$0.10 gas tax is needed over the next 5 years to compensate for the short fall in the Blueprint revenue, if the gas tax was the only source of generating new revenue.

The proposed NEXTEA refrains from changing federal budgetary practices by maintaining the flow of 4.3 cents motor fuel tax into the general fund. The California allocation level under the new formula would remain about the same as in the original ISTEA and the formula does not appear to account for high growth states. Further, the bill continues to exempt alternative fuels from the federal fuel tax and this would affect the amount California puts into the trust fund. This could be particularly significant considering that the growth rate in the alternative fuels market is projected to be higher in the west than in any other states. Air Resources Board's zero emission vehicles regulations would support continued growth in the alternative fuels market.

To ensure equity, the rate of alternative fuel consumption in individual states should be considered in the funding formula. Also, moving the transportation trust funds off-budget and redirecting 4.3 cent fuel tax to the Highway Trust Fund would enable a larger annual program, therefore, creating larger tax receipts for California. Under the new bill, the Congestion Mitigation and Air Quality Improvement program (CMAQ) would increase by more than 25%, to \$1.3 billion annually. While an increased level of effort on travel management control measures could have beneficial environmental consequences, although not well documented, it could impact transportation revenues in terms of reduced rate in VMT growth and fuel consumption.

**Consistency and Predictability:** Clearly, the gas tax is a viable and significant source of revenue which should be considered as a short term measure for additional revenue. Otherwise, the state may not meet transportation investment needs from other tactical financing measures and that would severely compromise California's transportation vision. A one cent gas tax would generate about \$130 million per year without additional administrative costs or technology investment. The important fact is that, however, in the long term, an increase in the gas tax alone is not a remedy for deficiencies of the current financing system. The effectiveness of traditional tax-financing methods has been under cut by structural changes in the transportation field, widening the gap between revenues generated and expenditures required to maintain an efficient transportation system. Indexing the gas tax is politically unpopular. However, a variable tax rate policy with defined parameters could provide a minimal cushion against some the uncertainties impacting transportation revenues.

While the fuel tax was originally conceived as a direct user-fee, it no longer lend itself to discrete pricing of road access. The linkage between the gas tax and the use of transportation facilities has been weakened, due mainly to technology improvements and the lack of price indexing. This is to the point that the more one drives, the less one proportionately pays, given continued improvements in vehicle performance. It is estimated that improvements in fuel economy of light duty vehicles could potentially result in a revenue opportunity loss of \$488 million by 2005. The market share for alternative fuels would potentially increase the revenue loss by an additional \$118.6 million at the same time.

Other state and federal programs would further diminish transportation revenues. For example, 23% of the federal tax receipts is currently appropriated to federal budget deficit reduction. Income from a transfer of the 4.3 cent motor fuel tax to the Highway Trust Fund would enable an annual increase in transportation programs, assuming that obligation ceiling is raised. Therefore, it is critically important to maximize the use of transportation dollars regardless of the need for programming reform. Transportation investment policy and objectives should be clearly defined, linking investment strategies with a cost-effective resource allocation process. This should take place along with a long term structural reform in the fuel-based financing system to ensure integrity of the budgetary process as well as equity for transportation system users. Market based strategies, such as return-on-investment, appears a right direction for guiding investment decisions and as a means of comparing costs to earned revenues within the context of differential road pricing.

**Technology Requirements:** It is necessary to identify policy options and investment strategies for an appropriate pricing technology. The system

architecture for the technology infrastructure should be developed in order to facilitate reform. The cost for this effort is limited to the planning phase and selection of a demonstration project for initial testing.

### **Summary Comparison**

The following table (next page, table 17) summarizes the comparison and compatibility of the existing fuel based system, the VMT pricing system on full freeway system, and the combined system based on stated evaluation criteria. The qualifying statements are taken from the scenario analysis and simplified to provide a side-by-side comparison of the major alternatives. The example illustrates potential values associated with the fuel based system and a transition to a dual revenue system with the introduction of a VMT fee.

**Table -17**  
**Summary Comparison**  
**Fuel Based System, VMT Fee System, and Combined VMT/Gas Tax**

<u>Criteria</u>	<u>Fuel-based System</u>	<u>VMT pricing/Full Freeway System</u>	<u>Combined VMT fee/ gas tax (incremental Approach)</u>
Revenue	inadequate if current tax rate is maintained. require major tax increase to meet transportation needs.	adequate at moderate VMT fee. unequitable at high VMT fee	adequate with low VMT fee and current gas tax rate.
Consistency predictability	relatively stable. consistent with rate of fuel consumption.	relatively stable. consistent with rate of VMT growth.	stable. tradeoffs with instability in rate of VMT growth and fuel consumption.
Effectiveness/ Economic Efficiency	not responsive to rate. indirectly linked to VMT or facility use.	not responsive to inflation. VMT rate is more in line with inflation rate. directly linked to use of facility.	not responsive to inflation. overcomes lack of inflationary indexing.
Equity	less than equitable. does not differentiate between classes of roads, level of service. tax rate below cost responsibility, under pricing of facility use. variable marginal marginal cost per mile.	relatively equitable. responsive to vehicle class, facility type, and level of service. can be responsive to vehicle cost responsibility. consistent marginal cost per mile.	relatively equitable. potential to reduce gas tax and other fees. relatively responsive to vehicle class, facility type, and level of service. can relatively be responsive to vehicle cost per mile. variable marginal cost per mile.
Political Feasibility	tax increase conditionally acceptable.	improving acceptability. concept not well known.	potentially acceptable.
Implementation	very convenient. administrative cost low. potential for tax evasion low (5%). compliance cost low.	complicated. require considerable capital and administrative cost. potential for tax evasion high initially (15%). compliance cost relatively acceptable.	complicated but feasible if implemented incrementally. administrative and capital cost fairly high for the first leg of the system, also high return-on-investment. potential for evasion relatively high for the VMT component, but acceptable given the scope. compliance cost moderate.
Technology	no new technology requirement.	practical technology not available. high cost.	basic technology available. modest cost.

## **CHAPTER VI**

### **Policy Options and Recommendations**

#### **The Most Feasible Alternative**

In preceding pages, potential alternatives were analyzed based on a number of prominent factors which would likely affect surface transportation revenues and transportation energy use in California. The analysis evolved against the base case scenario based on the existing system characteristics. The revenue alternatives selected for the study were shown to be sensitive, in variable degrees, to future scenarios and factors determining future directions. Some of these factors are external to the transportation decision making environment and conditioned by factors that cannot be easily influenced by policy makers, such as economic conditions or technological improvements. Transportation officials may be able to influence certain policy direction, such as national environmental and energy policies, including transportation legislation (i.e. NEXTEA), and to a greater degree state policies (i.e. Blueprint). The intent of this study was to sketch future scenarios and evaluate impacts of significant factors on transportation revenues in order to provide policy makers an analytic basis for policy decisions. To what extent policy makers can influence these conditions was considered external to the evaluation process. Consequently, while transportation leaders should continue to influence the direction of transportation related policies, they must be prepared to deal with the complicating effect of these factors on future revenue streams.

It is, therefore, useful to define parameters within which transportation officials are willing or able to take leadership in order to shape the transportation future. There are two basic elements in this process. One is to critically analyze the causal factors contributing to transportation system needs and revenue requirements. The other is to taking steps to deal with the consequences of these factors. The alternative scenarios and analysis presented in this report should be useful in exploring policy options and for taking concrete steps in realizing future needs and to ensure integrity of transportation system and its financing structure.

The fundamental policy issue is whether the current financing system should be “reformed” or “transformed” in response to a range of factors undercutting its structural efficiency. The answer, in part, lies within the technological capability which makes a shift to a new form of measuring and taxing vehicle miles of travel more effective. There is an obvious need for recognizing significant challenges that California’s transportation is facing in the coming

decade. Political will, leadership, and a concerted effort among stakeholders are necessary to meet these challenges and carry the transportation system into the 21 century based on a sound financing system.

The four alternative revenue sources discussed earlier attempt to provide a reasonable assessment and underline the type of options available in reforming or transforming the existing system. The basic factors considered in the evaluation framework of these alternatives are interdependent. There will typically be many possible combinations, but some are more consistent with transportation realities and can be better packaged or more effectively integrated. Given the strategic objective of this analysis and the evaluation framework; two alternatives remains viable:

- Fundamentally maintain the existing financing system, but make certain reform (near-term, next 5 to 10 years).
- Initiate an incremental transformation of the existing financing system: A combined fuel-based system and VMT pricing on full freeway system (mid-term, next 10 to 15 years).

It is clear that transportation energy sources will continue to be dominated by fossil fuel in a foreseeable future, although fuel infrastructure is becoming increasingly more diversified. At the same time, technological capability, while advancing, is limited and implementation requirements are complex. A shift to a fundamentally new financing system is totally infeasible and, indeed, impossible. More importantly, the existing fuel-based system from the revenue point of view is still relatively stable. Further, it would provide a supporting environment for experimentation and demonstration of market-based strategies. The analysis in this report underlines packaging of potential new sources and improvement measures. Consequently, combining the elements of reform (near term) and transformation (mid term) together in a package appear to be most promising in fundamentally changing the transportation financing system.

- A Combined “Reformed Fuel-Based System” and Incremental Introduction of “value oriented pricing” on the state highway system. This could include introduction of “VMT Pricing (variable rate) on Full Freeway system” for developing a statewide pricing system.

The risks associated with any fundamental change and the nature of policy development imply that financing reform and transportation pricing will only progress incrementally. This process will help convince policy makers and the public about the effectiveness of the pricing strategies or could identify flaws in the system along with the opportunities to refine or redefine policy objectives.

## **Recommendations**

A commitment to long term thinking is fundamental in resolving transportation financing problems. Improving the existing transportation financing system is the priority which must go hand-in-hand with its long term transformation. The State transportation system, particularly the highway system, is directly effected by the financing structure and methods of funding allocation. It is recommended that Caltrans initiate a systematic process to set the stage for reform and an incremental transformation of the existing surface transportation financing system. The intent is long term structural change in the way transportation revenues are generated and allocated. Tactical financing initiatives, although important, are considered secondary in this process.

A two-pronged approach is proposed which defines a new direction based on a dual revenue system and a more direct link between transportation finance and the benefits generated from transportation services. This would require a higher accountability on the part of transportation providers in terms of achieving specified sets of strategic objectives in return for a higher cost responsibility on the part of transportation customers. Experience suggests that taxpayers and clients of the transportation system tend to support a balanced approach where desirable transportation improvements are clearly defined and where public investments and the funding allocation process is clearly accounted for.

The difficulty in changing the current financing system and practices primarily resides within the political process by which the need, interest, role, and responsibilities of transportation system and stakeholders are defined and agreed upon. Caltrans needs to provide systematic support for transportation financing and alternative funding analysis. Continuing planning and policy evaluation in this area is functionally significant where it has historically been confined to ad hoc studies and policy exercises. This study provides a preliminary, but systematic framework for evaluating alternative revenue sources, and a basis for creating a new program to focus on the complex and critical issues of transportation financing.

### **A. Reforming the Fuel Based System - near term Implementation options (5 to 10 years)**

There is no magical formula that could change financial imbalances quickly and effectively. At the same time, contrary to some dramatized arguments, there is no fundamental crisis in transportation financing, although a warning of future financing trouble is evident by most realistic analyses. There are major problems and funding deficiencies which requires serious and immediate attention. The reform of the existing system must be done

systematically and incrementally in order to resolve long term structural problems.

**Strategic Objectives:** The process of reform should be approached through three interrelated, but distinct systems and their strategic objectives. This requires; a) defining the function and strategic objectives of the future transportation system to be achieved; b) defining the role, responsibility, and accountability of the state and regions based on the stated transportation system strategic objectives; and c) identifying revenue generating mechanisms, distribution and investment strategies consistent with “a” and “b”. The lack of effectively articulating these layers of strategic objectives has created a vacuum for properly dealing with transportation reforms at all levels. This report has been primarily concerned with evaluating potential sources of revenue. However, the three aforementioned components must be dealt with integratively to ensure a total system approach and support from the transportation community at the state and regional levels.

**Allocation Process:** One of the critical elements in reforming the financing system is the criteria for transportation investment policy and the allocation process. This is currently lacking. The process of funding allocations must be revised based on strategies for optimum return-on-investment and market performance, on one hand, and progress toward transportation system objectives on the other. This requires legislative and policy direction guiding expenditures on transportation projects and revenues collected from users of the system. It is recommended that Caltrans, in coordination with the California Transportation Commission (CTC), study the framework for a value oriented transportation investment and allocation process.

**Tactical Financing:** Feasible tactical financing strategies and options are fairly straight forward and mostly known. In the near term, the current fuel-based financial structure and funding mechanisms are likely to remain generally unchanged. The funding shortfall may have to be dealt with administratively through streamlining the STIP and capital outlay, which means not achieving the transportation system strategic objectives. Implementing tactical financing strategies, such as improving market opportunities for debt financing and private investment in conjunction with other sources of funding are very appropriate, particularly at the local and regional levels. For example, NEXTEA proposes \$900 million and \$600 million over six years for the state infrastructure bank program and the credit reform program respectively. These strategies, however, do not provide adequate revenue nor are considered a revenue source. Funding transportation improvements from non-user fees, such as special assessments and impact fees, are also appropriate, but they are, more or less, tools at local and regional levels. While all these sources taken together

amount to significant funding for transportation programs in general, they cannot provide substitutes for fuel taxes.

**Private Sector:** The potential benefit for allowing the private sector to compete for a certain portion of the state roadway system, excluding interstate highways, under certain provisions, should be studied. Highway privatization statutes for new facilities exist in California. The Route 91 express lane project and similar projects elsewhere should be studied for potential enhancement of the privatization program. Provisions concerning privatization and identification of specific route segments to be available for competitive bidding require careful consideration and evaluation.

**Gas Tax:** While the nature of gas tax financing is inconsistent with the market approach to transportation investment since taxes are not prices and cannot be adjusted with the same degree of precision as prices or fees, a possibility of a limited term modest increase in gas tax should be evaluated. This temporary measure might be the only source of quick and significant revenue outside of the sales tax which could partially resolve the funding gap in the short term. The efficiency of the existing financing system would relatively improve because higher fuel taxes brings the overall charges closer to the marginal costs of travel. The implementation of such a measure must, however, be contingent upon initiating other programming reforms and until the VMT user pricing system is partially established (see next section). After this phase, the user of priced route segments should be entitled to refunds of gasoline, diesel, and weight distance taxes paid for the mileage driven on these road segments. As the larger VMT pricing system evolves and proceeds from user fees increase, the gas tax rate should begin to decline. This process should maintain an optimum balance between fuel tax and VMT fee, reflective of the fair market value of transportation services.

Further, California may need to consider a variable tax rate policy to minimize the systematic use of legislative processes and as an interim measure in reforming the existing system. In this case, fuel taxes are automatically adjusted at specified intervals in response to changes in fuel prices or in response to some index of prices or highway costs. A minimum and maximum ceiling should be set within which the rate would fluctuate.

**Alternative Fuels and Vehicle Economy:** As the earlier scenario analysis indicated, there is a need for formulating the proper fee structure for alternative fuels. This would not be a significant source of revenue in near term, but is a necessary step in establishing a systematic approach to transportation energy pricing. The fee structure for alternative fuels should be consistent with that of conventional fuel and not be determined by policies sensitive to alternative fuels and vehicles. Promotion and marketing of alternative fuels should be achieved through means other than differential

taxation. Aligning alternative fuels taxes with conventional fuels would also safeguard future revenue implications which are projected to be significant. It is also important to factor in vehicle fuel economy in calculating overall driving charges. The revenue opportunity loss due to vehicle efficiency has been significant and will continue, although with a diminishing rate. Both alternative fuels and vehicle efficiency are sensitive issues and their tax structure require careful evaluation. The long term strategic objectives concerning markets for alternative fuels and vehicles are important and should be maintained.

The proposed Federal Reauthorization Bill (NEXTEA) continues to exempt alternative fuels from the federal fuel tax. This would effect the amount California puts into the trust fund. This could be particularly significant considering that the growth rate in alternative fuels markets is projected to be higher in the west than any other states. Air Resources Board's zero emission vehicles regulations would support continued growth in the alternative fuels market. To ensure equity, the rate of alternative fuel consumption in individual states should be considered in the distribution funding formula.

**Sales Tax:** Sales taxes are a major part of the local transportation picture. In light of the Gaurdino decision and proposition 218, they will likely remain at the current level, unless such restrictions are lifted. Considering that nearly all of the county sales taxes will sunset by 2010 or earlier, the need for transportation financing reform becomes even more critical.

**Facility Specific User Fee:** The facility specific user fee, such as toll bridges, roads and hot lanes, has been and is becoming increasingly more significant element of transportation financing and travel demand management, particularly at the local level. The viable congested corridors or sub-areas should be identified for potential pricing applications. Caltrans should support and assist regional agencies in developing those programs. The toll collection process must be upgraded to an ETC system to improve equity and efficiency, making the use of toll booth obsolete. The state should evaluate the potential application of tolling certain segments of the interstate system. The existence of single facility pricing projects at regional levels would facilitate implementation of a larger system wide VMT pricing in the longer term. The issue of system and technology compatibility of these regional sub-systems should be carefully assessed. In light of the uncertain sales tax status and depending on the gas tax potential, facility specific tolls may be the only source of significant revenue for transportation investments outside of fuel taxes in the near term.

**ISTEA and Devolution:** The potential for structural reform in the existing fuel based system, which would underline the linkage between transportation

financing, performance objectives and the users of the system, should be more specifically recognized in the National Economic Crossroads Transportation Efficiency Act of 1997 (NEXTEA). The proposed NEXTEA encourages creative financing (mainly tactical), but maintains virtually the same level of funding as its predecessor. The bill refrains from changing federal budgetary practices by maintaining the flow of 4.3 cent motor fuel tax into the general fund. The California allocation level under the new formula would remain about the same as in the original ISTEA and the formula does not appear to account for high growth states. The revenue implication of factors included in the formula should be closely examined. Also, moving the transportation trust funds off-budget and redirecting 4.3 cent fuel tax to the Highway Trust Fund would enable a larger annual program, therefore, larger tax receipts for California. In addition to continued exemption of alternative fuels, the increase level of Congestion Mitigation and Air Quality program should be evaluated for its efficiency as well as potential revenue implications. California needs to actively engage in the debate over the next year, particularly on the issue of the funding formula which remains complex, federal mandates and reporting requirements, and transportation pricing in order to influence a higher and more equitable funding level than it received under ISTEA. Reforms in ISTEA would contribute to more effective decision making and allocation processes concerning major transportation investments.

**Partnership:** The use of the VMT pricing method as a revenue source and for the purpose of air quality and travel demand management is methodologically and strategically consistent. Regardless of strategic objectives and ideological attachments, state and regional agencies should work closely together on the common objective of transportation pricing and collectively facilitate financing reforms, such as ones suggested in this report. Creation of a statewide working group on transportation financing is appropriate.

#### **B. Introduction of VMT Pricing (variable rate schedule) on Full Freeway System: Emerging System -mid term (10 to 15 yrs.)**

Along with reforming the existing financing system, the department needs to critically analyze viable alternatives, evaluate strategic policy options and ensure an incremental transition from a fuel-based system to a dedicated user fee transportation financing system. The analysis in this report supports feasibility of a staged VMT pricing system on the access controlled freeway system within the next 10 to 15 years.

**New Program:** Structural reform of the current financing system must, in the long term, evolve out of the basic linkage between transportation financing and the benefits generated from transportation programs and

projects. The relationships between transportation services or strategic objectives, specific types of taxes paid by the users of the system, as well as the level of funding, must be clearly defined. The emphasis would be on providing a certain level of transportation services for a given period of time, in return for the system user's commitment to a specified user fee. This would allow transportation agencies to develop programs, revenue sources, and funding levels which can be demonstrated to be most effective both in terms of transportation operations and the interest of the public. It is recommended that Caltrans create a new program to establish a framework for a continuing planning and policy analysis on transportation pricing and investments, beyond ad hoc studies. A systematic approach in evaluating pricing issues and alternative financing both in terms of revenue and return-on-investment, including transportation energy efficiency as well as transportation users' interest is needed. It is timely to initiate a process through which transportation stakeholders are systematically brought together to focus on a coordinated effort in reforming the transportation financing system. Creation of a task force consisting of the department, CTC, regional planning agencies and local authorities, and other stakeholders might be prudent.

**Alternative Fuels and fuel economy:** Within the next twenty years, fossil fuels will continue to dominate the transportation fuel structure. Based on the existing financing system, fuel tax receipts will still be substantial, but increasingly deficient. The penetration of alternative fuels and vehicles would become potentially significant, reaching over a million based on certain projections. Combined with higher fuel economy scenario, it would likely to result in worsening the equity of tax structure and further erosion of transportation revenues. Restructuring the alternative fuels taxes is necessary and should be aligned with gasoline and diesel prices to ensure consistency and equity in transportation energy taxation. However, in the long term, incremental implementation of mileage based user fee would move away from taxing the fuel consumption to pricing the amount of travel or use of facility, therefore, minimizing uncertainties associated with energy taxation for transportation purposes. The current fuel rate structure is sensitive to policies concerning alternative fuels or vehicle efficiency. Promoting diversity in transportation energy resources is necessary and could still be achieved through other means than differential tax rates.

**VMT Pricing:** A system or region-wide application of user fee mechanisms appears viable within the next 10 to 15 years. The practical possibilities for implementing more complex schemes, such as the VMT fee, are changing rapidly with new development in automated vehicle identification and charging. A phased program evolving out of a defined regional freeway system appears practical and the process of identifying such sub-systems should be studied. The feasibility of this pricing program should be tested

through a carefully designed demonstration program. Demonstrating (VMT) modern electronic road pricing technology at work in a pilot project would be a means of overcoming many obstacles that exist in implementing and maintaining such a complex program. It is recommended that Caltrans initiate development of the preliminary system architecture for VMT pricing systems on full freeway networks, including institutional and interjurisdictional issues and compacts. As part of that process, potential core sub-systems (initial leg) should be identified and their feasibility evaluated. While the pricing concepts and methods evaluated in this report are equally applicable to heavy duty trucks and buses, it is recommended that the implications of the VMT pricing system for this vehicle category be further evaluated.

**Institutional, Interjurisdictional, and Administrative Requirements:** Given the differences in existing laws and practices across the localities and regions, any large scale project or reform would be quite complex and complicated. There is a need to closely examine interjurisdictional issues and suggest creative and practical institutional and organizational arrangements. It is clear that the success of a system wide pricing program and fundamental reform in transportation financing evolves out of a cooperative and coordinated approach based on common interest. A formation of a local, regional, and state pact to jointly evaluate institutional feasibility is desirable.

**Technology:** The state would need to adopt a statewide technology standard for ETC. Caltrans should initiate a process through which a reliable, cost-effective ETC system and vehicle on board equipments can be evaluated for statewide application. The tactical and strategic issues involved in a system wide application of a sophisticated pricing technology should be evaluated. Technology responsiveness to tampering and enforcement must be assessed. Mechanisms for making transponders available to millions of registered vehicles using the priced system need to be worked out. The issues concerning out-of-state or out-of-region travelers need to be resolved.

**Legislative and administrative authority:** The fundamental reform of the existing financing system, particularly transportation pricing requires legislative and public support. It is necessary to develop and implement an educational and outreach program to communicate effectively with stakeholders, policy makers, legislators, and the public concerning issues discussed in this paper. It is important to explore support and authority necessary to carry out reform in transportation financing. The equity and perceived fairness is critical in transportation pricing. There is evidence of greater public support for fees directly linked to providing transportation services where revenue expenditure and performance of the transportation system and providers are accounted for properly.



Questions and comments concerning this study can be directed to the author, Reza Navai, Ph.D., AICP, 916-653-3424, Transportation Planning Program, MS 32, California Department of Transportation.

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